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Facts About the Panama Canal

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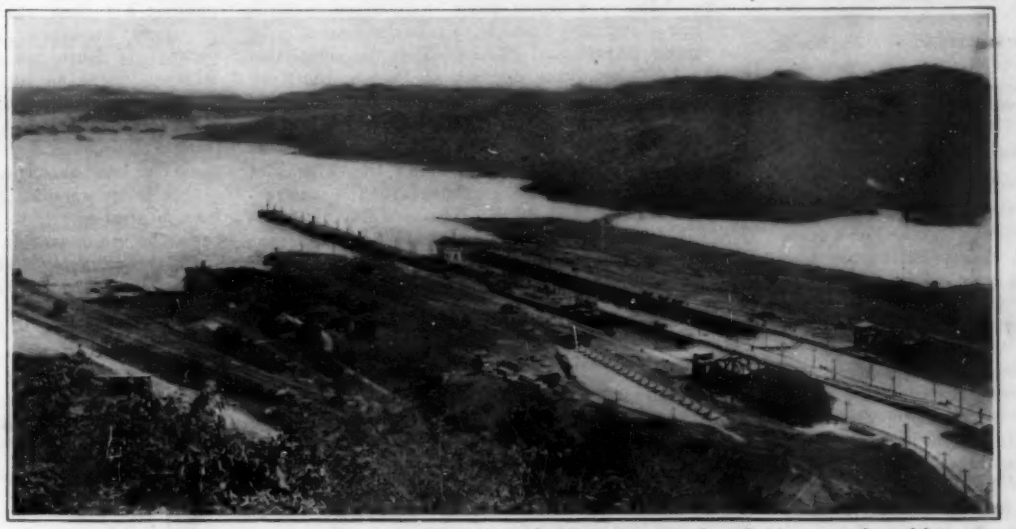
Formerly Superintendent of the Pacific Locks

A CAREFUL study of traffic through the Canal, involving the passage of approximately 2,000 commercial vessels, shows that the maximum capacity of the Canal locks, conservatively estimated, is sixty average size steamships a day; the expected capacity was about forty-eight ships. Frequently, however, one of the twin flights at each set of locks must be closed to traffic for the overhauling of the submerged equipment, especially the large valves and gates, as deteriorating forces are constantly at work and protective measures must be taken to preserve the life of these parts. At such times the Canal will have a maximum capacity of about forty ships a day.

The Commander of the United States Naval Academy practice squadron, consisting of the battleships Missouri, Ohio and Wisconsin, which passed through the Canal on July 15th and 16th, 1915, forwarded a report to the Navy Department reading in part as follows: "With respect to locking the Missouri and Ohio through Pedro Miguel and Miraflores Locks simultaneously in parallel, with the Wisconsin directly in the rear; the centering and control of the vessels by towing locomotives was so nearly perfect that a division of four ships, the size of these or somewhat larger, could be handled at the same time, two in each of the duplicate chambers. In the case of dreadnoughts the length of the ships would prevent the handling of more than one in each chamber, or two at a time. However, the entire present main battleship fleet, made up of four divisions of five ships each and a flag ship, a total of twenty-one, could be passed through the Canal in a single day." At the Gatun Locks, which have the total three lifts combined in a single flight, it is possible to handle eight average size vessels such as the above simultaneously, four being raised in the upper twin chambers and four in the lower, and the other operations through the entire flight taking place with a corresponding sequence.



General view of Pedro Miguel Locks, with S. S. Cristobal being raised, and other vessels waiting

Battleship Wisconsin entering Gatun Locks

Battleships Missouri and Ohio in lower locks at Miraflores; Missouri leaving chamber

To lock a ship the size of the "Kroonland" or larger requires 8,000,000 cubic feet of water (4,000,000 for locks at each end of the Canal). To lock the larger size of ocean freighters requires in general 5,500,000 cubic feet, as the intermediate lock sections can be used; and to lock the average size vessel in tandem requires 4,000,000 cubic feet per vessel. Assuming that the average run of ships consists of one of the first class, two of the second, and seven of the third, the average amount required per vessel is 4,700,000 cubic feet, corresponding to a steady requirement of 54.4 sec. feet per vessel per day. Water must be stored during the wet season for dry season requirements. At present this is done only by raising the low elevation of Gatun Lake at 82 to its high elevation of 87, storing between these levels 22,800,000,000 cubic feet of water, which, if all available for lockages, would care for the passage of 4,850 ships. The allowance for power consumption is 1,000 sec. ft., for leakage and miscellaneous losses 100 sec. ft., for wet season evaporation estimated losses are 630 sec. ft. and for dry season 924 sec. ft. making the total wet season losses 1,730 sec. ft. and dry season 2,024 sec. ft. During the period January 1st, 1912 to May 31st, 1912 the discharge for these five months of the rivers into Gatun Lake was the lowest on record for 25 years, being only 1,174 sec. ft. This was less than one-half the average dry season discharge for the periods of record—of 2,900 sec. ft. This discharge is not sufficient to care for the losses and leaves a deficiency of 850 sec. ft., or cuts down the number of lockages from available storage capacity by about sixteen vessels per day. The stored water in Gatun Lake would therefore care for only sixteen vessels per day during the 150 days of the five months' period without making allowances for saving of water in cross-filling.

When the Canal traffic approaches about twenty ships a day to be safe as far as water supply is concerned for additional traffic it will be necessary to store more water during the wet season. An ideal location for a dam exists at Alhajeula where a dam could be built that would provide an additional capacity of about 12,000,000,000 cubic feet (Gen. Abbott estimates 15,000,000,000, but others are more conservative). This water would provide sufficient water for lockage of at least 2,100 additional vessels or for the period mentioned increase the number of vessels from sixteen to thirty vessels per day. Allowing for cross-filling would increase this to about thirty-three vessels per day. This as mentioned previously is based on the minimum dry season flow for five consecutive months in five years and at the end of the five months the channel depth would be 42 feet. This

(Continued on page 161)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Congress and the National Defense

IT must be admitted that when Congress, answering the unmistakable call of the country, once began to build up our national defense, it worked on a scale, so far as authorizations and appropriations are concerned, which has never been equalled in this or any other country. The greater part of this energy, of course, is being expended in merely making good the shameful neglect of the past ten or twelve years. If Congress had been guided more by patriotism and less by politics, our Navy, our Army and our coast defenses would have been built up year by year, proportionately to the increase of the country in wealth, population and international responsibilities, and there would have been no call for such vast outlays of money as are now being made. It is well for us, here, to remind ourselves that, between the voting of money and the completion of ships and fortifications and the raising and equipping of armies, there is all the difference—the wide and fateful gulf—between preparedness and unpreparedness. It is not sufficient for Congress to vote the appropriations; it should lend every possible legislative impulse and inducement to the swift completion of the emergency program for national defense which has now been laid down.

The defense appropriations for the present year total about $800,000,000. The sum is made up of $351,000,000 for the Navy; $360,000,000 for the Army, and over $51,000,000 for coast defenses, the last named sum having recently been passed by the House. Numerous deficiency measures, resulting from the Border mobilization and the rising cost of war materials, will bring up the total to the above mentioned sum of over three-quarters of a million dollars. The universal military training bill, at the present writing, is before a Senate sub-committee and we note that during his recall for cross-examination, Gen. Wood spoke of the National Guard as a vicious and indefensible system and advocated, in unmistakable terms, a complete reorganization of the Army under exclusive Federal control, without a shadow of State interference. The General, in common with every ranking officer of the army, is in favor of universal military service, and there is every evidence that the opinion of our Army is backed up by the vast majority of the thinking people of the country.

Last year the Navy Bill carried $313,000,000; this year the amount is $351,433,245. The bill provides for the construction of three great battleships, of 42,000 tons, which is about thirty per cent greater than that of our largest dreadnought, the "Pennsylvania." The ships will carry the truly enormous battery of twelve 16-inch 50-caliber guns, each of 120,000 foot-tons energy. The total cost of each ship is estimated at $28,178,592. The bill also calls for one battle-cruiser of 35-knot speed, mounting ten 50-caliber, 14-inch guns, to cost $26,694,496; three 35-knot scout-cruisers, each to cost $6,746,145; fifteen destroyers; one destroyer tender; one submarine tender and eighteen 800-ton type submarines.

With the exception of the submarines, the House Naval Committee followed the three-year program as recommended by the Department, and it will be a matter of congratulation among the line officers of our Navy that no more of the small and inefficient cost-defense submarines, of about 500 tons displacement, are called for. These coast-defense submarines are not sea-keeping, cannot cruise with the fleet, have insufficient accommodation for the crew, both as to berthing space and the capacity to carry supplies, and altogether represent a poor investment of the Nation's money. The 800-ton submarines have been recommended largely on the strength of the evidence of our submarine officers, and of the naval constructor who was detailed to cruise with the fleet and observe our small coast-defense submarines in all kinds of weather. Eight hundred tons is about the size of the German submarines which have done such excellent long-distance work for the German Navy.

In order to facilitate the securing of bids for the four battle-cruisers authorized last year, the Committee raised the limit of cost for the hull and machinery alone, from $16,900,000 to $19,000,000 each. The Department believes that all four vessels can be placed with private bidders at that figure. At the same time, the Committee recommends the expenditure of an additional $12,000,000 for the laying down of shipbuilding ways and the building of shops, to enable the Government yards to undertake part of the naval construction each year. This sum is to be available only in case the Department is unable to make satisfactory contracts for any vessels in the present program or left over from last year. For the three scout-cruisers, not yet contracted for, the Committee raised the limit of cost for hull and machinery from $5,000,000 to $6,000,000 per ship.

One of the most urgent needs of the Navy to-day is drydocks of sufficient capacity to take the great ships of the three-year program. To encourage the completion of the 1,000-foot State drydock at Boston, the Navy proposes that the Secretary of the Navy be authorized to guarantee $300,000 worth of Government work to the construction of the dock. This agreement would be similar to that made with the Union Iron Works of San Francisco some time ago to encourage the construction of a large drydock on San Francsico Bay.

A commendable provision of the bill of the House Naval Committee is a provision which raises the number of appointments annually at Annapolis to be made from the enlisted personnel of the Navy from 25 to 100.

American Export Enterprise

THE fourth National Foreign Trade Convention recently held at Pittsburgh, was a most enthusiastic and inspiring gathering, representing American manufacturers and business men in all quarters of the country. It was by far the largest assemblage of the sort ever held in America and it augurs well for the extension of our trade to all quarters of the globe.

The handicaps that have hampered the American manufacturer hitherto, have been, first, competition with highly organized groups or trusts of foreign manufacturers; second, the lack of proper American banking facilities; and third, an inadequate American merchant marine to carry our goods directly to the lands where they were to be sold. Since the war has removed much of our competition and left us with a free hand to extend our export trade, we have been aroused to the necessity of developing the proper financial facilities abroad and we are educating foreign customers to translate the value of their moneys directly into United States monetary standards, instead of converting pesos first into pounds sterling and then pounds sterling into American dollars. The financial outlook therefore is very bright, but we are still faced with the other two handicaps.

The Webb Bill, to which we have made reference before in these columns, aims to remove the restrictions of the Sherman law from the exporter, so as to enable American manufacturers to combine and cope more successfully with the team work of foreign manufacturers. It seems probable that this bill, which has already passed the House, and which has the support of the Administration, will also be passed by the Senate during its present session. Otherwise, American manufacturers will be obliged to wait until another term of Congress, and it is clearly evident that at this critical time in the world's history, delays may result in serious consequences.

As for the third handicap, that of furnishing American ships to carry American products, while it does not seriously affect our trade in the present unusual conditions of shipping, we are sure to find ourselves in a critical situation at the close of the war, unless some radical changes are made in our maritime regulations.

We have an opportunity now such as never will be presented to us again. In all parts of the world American goods are being bought because of the lack of other products. No matter how prejudiced a customer may have been against American manufactures, he has been obliged to buy them and has found them far better than he had expected. In many cases, he has found them superior to the products of our foreign competitors.

Perhaps the most encouraging paper presented at the convention was the one which gave some examples of American export enterprise. It showed that without the aid of war conditions and despite all handicaps, the export of our manufactures nearly doubled between 1905 and 1913, when our total for the year was close to $800,000,000. Our manufactured products have not only been carried into South America and Africa, but into European lands, where they have sold in direct competition with European products. We have been wont to criticize the American manufacturer as a novice at export trade, but we find that American advertising and selling methods have enabled us to compete successfully in the very centers of European industry. We are constantly being told that the American manufacturer does not know how to pack his goods, that they reach their destination in seriously damaged condition because the shipper did not realize the handling they would receive abroad. We are also told that the American manufacturer does not try to adapt himself to the requirements of foreign peoples, but attempts to force upon them American goods which are entirely inappropriate and unfitted for foreign use. It was brought out at the convention that while this may be true in a certain measure, it is also true of European goods in fully as great a measure. There are plenty of instances of improperly packed goods sent out from England and Germany. As a whole, American goods are properly packed and the majority of exporters have made a study of the conditions prevailing in the country in which they are trying to introduce their goods.

It is very significant that our own criticism of American packing has been utilized by foreign competitors to disparage American merchandise and increase the prestige of European goods. It is time we ceased criticism based on broad generalities. With the unparalleled opportunities that lie before us to-day, there is no reason why we should not become the leaders in foreign trade, provided our manufacturers are given the same free hand that is enjoyed by their competitors.

One thing we must not forget. This war has also been of great service to European industries in teaching them the use of machinery on a vast scale, in showing them the advantages of organization, and also in introducing industrial efficiency into their factories. They have been awakened as never before to the advantages of scientific research in connection with their industries. If America is to hold the position that she should after the war, we must bend every effort to develop our industries to the highest efficiency and to use our facilities for industrial research to the maximum.

German Submarines and Our Harbors

NOW that Germany has thrown overboard the pledges which she gave to the United States after the sinking of the "Suffolk," and has cast all considerations of humanity to the winds, the United States has been brought as close to the possibility of war with Germany as the eyelid is to the eyeball. It seems to be generally assumed that if, as the outcome of Germany's submarine policy, there should be war between the two countries, it would be ushered in by some formal declaration of war. On our side, it might be; but we are fully convinced that the only declaration of war which Germany would ever make would take the form of the sudden appearance of her submarines in our harbors and a savage attack upon our naval and merchant ships. In other words, we should see a repetition on a larger and more frightful scale, of the torpedo attack on Port Arthur with which Japan commenced hostilities against Russia. The ships lost by Russia by that surprise attack, so weakened her that Japan at once obtained the command of the sea.

This is the third time that the SCIENTIFIC AMERICAN has warned our authorities that they should forestall any such attack, by netting the entrances to our harbors, naval dock yards and naval stations. It is pretty safe to hazard a guess that, not only has no provision been made for netting our entrances, but that there is not in the country to-day a square yard of netting of the character which is being used so successfully in European waters. Why is it that the vast British fleet has been maintained intact at its naval bases during the intervals when it was not maneuvering, or cruising in the North Sea in search of the enemy. Unquestionably the German Admiralty, through its Zeppelin scouts, has known in what bays, or harbors, the vast British fleet had its moorings. It is equally certain that the German submarines have prowled around the entrance to these stations as eager to get at that mighty fleet which was throttling the life out of the Fatherland, as a pack of famished wolves hunting for their prey. So, also, they have known that just beyond the Straits of Dover, the millions of the British Army, with all their vast equipment, were being carried in safety to the continental battlefields. Why have the German submarine commanders been so balked of their prey? Certainly not for lack of initiative and daring; for in these they have shown themselves to excel.

The answer is to be found chiefly in the vast system of heavy chain nets which guard the home stations of the fleet and render safe the vast system of ferriage across the English Channel. Nevertheless, after two and a half years of war, in which these facts have been perfectly well known to us, we find ourselves with our harbors, naval stations, dock yards, roadsteads and even the entrance to the Panama Canal itself, unnetted and offering an unobstructed fairway for enemy submarines.

Is the entrance to Guantanamo Bay netted? We sincerely hope so; for if it is not, and the reports of German submarines being on this side of the Atlantic are correct, we might conceivably learn some morning that half of our dreadnought fleet is at the bottom of Guantanamo Bay.

Naval and Military Notes

Overproduction of Munitions in Great Britain.—The maximum point in gun and shell production has been reached in Great Britain, and there will be a gradual return of plants and labor to domestic production and export. The Ministry of Munitions states that there are now 4,623 plants controlled by the government, in addition to the regular government factories, and that in these factories are engaged no less than 2,225,000 employees. That a great proportion of labor is so employed is shown by the fact that about one-half of the entire membership, 5,000,000, of the trade unions is engaged in munitions making.

Growth of Munitions Output.—The increase of munitions output between June, 1915, and December, 1916, as given by the British Ministry of Munitions, is as follows: For every heavy howitzer produced then, 323 are produced now; for every field howitzer produced then, there are 46 produced now; and for every gun of medium size produced then there are 66 now. The output of 60-pounders and 6-inch guns went up eighteenfold and has now dropped back to twelvefold, as the supply is too great. In a single day as many shells for heavy guns are made as were turned out during the whole first year of the war, and in a week, the factories turn out as many shells for field howitzers and 3-inch field-guns as were turned out in the first year of the war.

Incendiary Bullets for Aircraft.—We are reliably informed that the British aircraft for the defense of England against aeroplane raids are now armed with an incendiary bullet which has proved to be very efficient, and that it was the use of these bullets which set on fire the Zeppelin which was brought down in flames a few months ago on the outskirts of London. The bullet carries a charge of highly inflammable and smoke-producing material, ignited on discharge, which as it is passing through the envelope and ballonets of a Zeppelin ignites the contained gas. As the attacks are made by night, the course of the flaming projectile is clearly visible to the aeroplane gunner, who is thus able to bring his stream of bullets on to the Zeppelin without difficulty.

A Reserve Supply of Sodium Nitrate.—The sore straits to which Germany has been put in the matter of high explosives by the blockade, which has cut her off entirely from the great source of supply in Chile, is an object lesson of which note has been taken by this country. Evidence of this is seen in the proposal to utilize water power in hydroelectric plants for the extraction of nitrogen from the atmosphere. The Chief of Ordnance also, in his annual report for 1916, stated that in his last report he drew attention to the important part played by nitric acid in the manufacture of smokeless powder and high explosives, and to the fact that nitrogen in nitric acid is obtained from sodium nitrate. Congress has met this situation by appropriating a considerable sum for increasing the reserve supply of sodium nitrate.

Shipbuilder versus Submarine.—One-half of the total tonnage of the British merchant marine has been withdrawn for war purposes and the losses of the other half, by mine, torpedo and submarine, have increased to a point at which it becomes necessary for Great Britain to make good the loss by building new ships, as expeditiously and in such numbers as may be necessary. Numerous orders have already been placed for a new standardized type of ship of about nine thousand tons dead weight. These cargo boats will be single deck, of simple and inexpensive specification, and both hull and engines are standardized. Orders for twenty have been given on the Clyde and about fifty in all have been contracted for. As completed the vessels will be taken over by the Admiralty and used for grain and food carrying. The naval program is about completed and British shipyards can now turn their vast capacities to account in combating the submarine menace by construction of merchant ships, which it is admitted they are perfectly well able to do.

The Shipbuilders and the Navy Program.—Recently, before the House Naval Committee, the shipbuilders stated that the principal reason for the lengthy period required for the construction of battle-cruisers was the shortage of labor, and they have made it known that although they could keep their yards fully employed on private contracts and that although private work was far more profitable, they were willing to reserve a portion of their plant for government work, if satisfactory arrangements could be reached, because they were desirous of helping out the government in the present emergency. The Cramp Company would devote one-third of its plant to a battle-cruiser on the basis of 10 per cent on direct and indirect costs; the Fore River Company is willing to take two ships and will be satisfied to leave the question of profit to be determined by the Federal Trade Commission; while Newport News stated that if the Navy Department had shown a friendly attitude, they would have installed ways for the cruisers. We are informed on good authority that the Department is hopeful of letting contracts for these ships at an early date.

Astronomy

Tables for Rising and Setting of Sun and Moon.—The forthcoming 1919 volume of the American Ephemeris and Nautical Almanac will supply a long-felt want on the part of the public as well as astronomers by including tables for computing the times of rising and setting of the sun and the moon. These data for 1917 and 1918 have likewise been published by the Naval Observatory in a recent separate pamphlet.

Increased Interest in Variable Stars.—In the SCIENTIFIC AMERICAN of November 4th Mr. W. T. Olcott, corresponding secretary of the American Association of Variable Star Observers, published a short note, inviting owners of telescopes of 3 inches aperture or more to cooperate in the work of the Association. Under date of December 10th he reported that he had received fifty-three replies to this appeal. This remarkable result indicates a steady increase in the number of observers and a growing interest not only in variable stars, but in astronomical work in general.

Astronomical Meetings at Observatories.—The recent meeting of the American Astronomical Society at the newly constructed Sproul Observatory of Swarthmore College calls attention to the fact that it has been the policy of this society for some years to hold its annual meetings at some one of the active observatories of the country. This plan gives the members an opportunity of becoming acquainted with a larger number of observatories and of studying their equipment. At Swarthmore the members made use each evening of the new 24-inch refractor in observing celestial objects. The meeting next summer will be held at the Dudley Observatory, in Albany.

Meteors from the Pons-Winnecke Comet.—On the evening of June 28, 1916, Mr. W. F. Denning observed at Bristol, England, a shower of meteors coming from a somewhat indefinite radiant in the region between Boötes and Draco, and not belonging to any of the known periodic showers. Between 10.30 and midnight the number of meteors which could be counted by a single observer was about 40 an hour, which is quite equivalent to the number appearing during a pretty good return of the Perseids. Mr. Denning, who is the foremost living authority on meteors, states that he had never before observed a new shower yielding as many as 20 meteors an hour. He suggests that the shower probably had a cometary derivation, and states that the orbit of the Pons-Winnecke comet satisfies the conditions. The earth now approaches much nearer to the orbit of this comet than it formerly did, perturbations by Jupiter having introduced considerable changes in the latter.

Observations of Mira Ceti.—Observations of the maxima and minima of the famous variable Mira Ceti have been especially thorough since 1904. Of course the conjunctions of the star with the sun make it impossible to maintain a complete series of observations, but since 1904 the only phases missed were the minimum of 1910 and the maximum of 1912. An observer in New Zealand, Mr. Westland, has been able to observe the star throughout the year except for a period of one month in April-May. A tabulation of all the phases from 1893 to the end of 1915 is published by Felix de Roy in the "Memoirs of the Society of Italian Spectroscopists." A maximum of much less than usual brilliancy following a minimum of greater brilliancy than usual, occurred in January, 1915, while the second maximum in 1915 was about normal. M. de Roy finds that the "perturbation" in the ordinary succession of phases previously pointed out by Bemporad, was paralleled by similar disturbances culminating in the maxima of 1895, 1896 (second max.), 1906 (first max.), and 1907. Possibly there was a similar perturbation in 1899. No periodicity can be found in the recurrence of this phenomenon.

A Helical Meteor Trail.—Mr. W. H. Steavenson has communicated to the British Astronomical Association an account of a curious meteor trail observed by him last July. Within 5 seconds after the passage of a brilliant meteor he was able to sweep along the length of its persistent trail with the finder of his telescope, having a power of 25. He found the trail to consist of a perfectly regular series of undulations, the length of each from crest to crest being about 1 degree, and the amplitude about 15 min. of arc. Moreover, the form of the trail was obviously not a series of simple waves in two dimensions, but actually a helix, for the apparent waves were much brighter at their crests and hollows than at the nodal portions. In his 15-inch reflector, with a power of 55, each crest of the trail, except for its curvature and the absence of any nucleus, looked much like the great nebula in Andromeda. The trail was observed for 3 minutes, and during the whole of that time showed no perceptible drift or change of shape; hence its remarkable form was presumably not due to deformation by air currents. Mr. Steavenson raises the question whether the meteor itself could have had a helical motion, and how such motion could be explained.

Electricity

Departures in Fan Design.—At least two novelties are to be included in the electric fan offerings of the 1917 season. One of these is in the form of an 8-inch aeroplane propeller which takes the part of the usual four-bladed metal fan, and for which a number of advantages are claimed. The other fan, while of the four-bladed variety, has no two blades exactly alike and they are not of exact peripheral diameter. The claim is made that since the blades travel in different planes, the hum so often evident and objectionable in motor fans is eliminated.

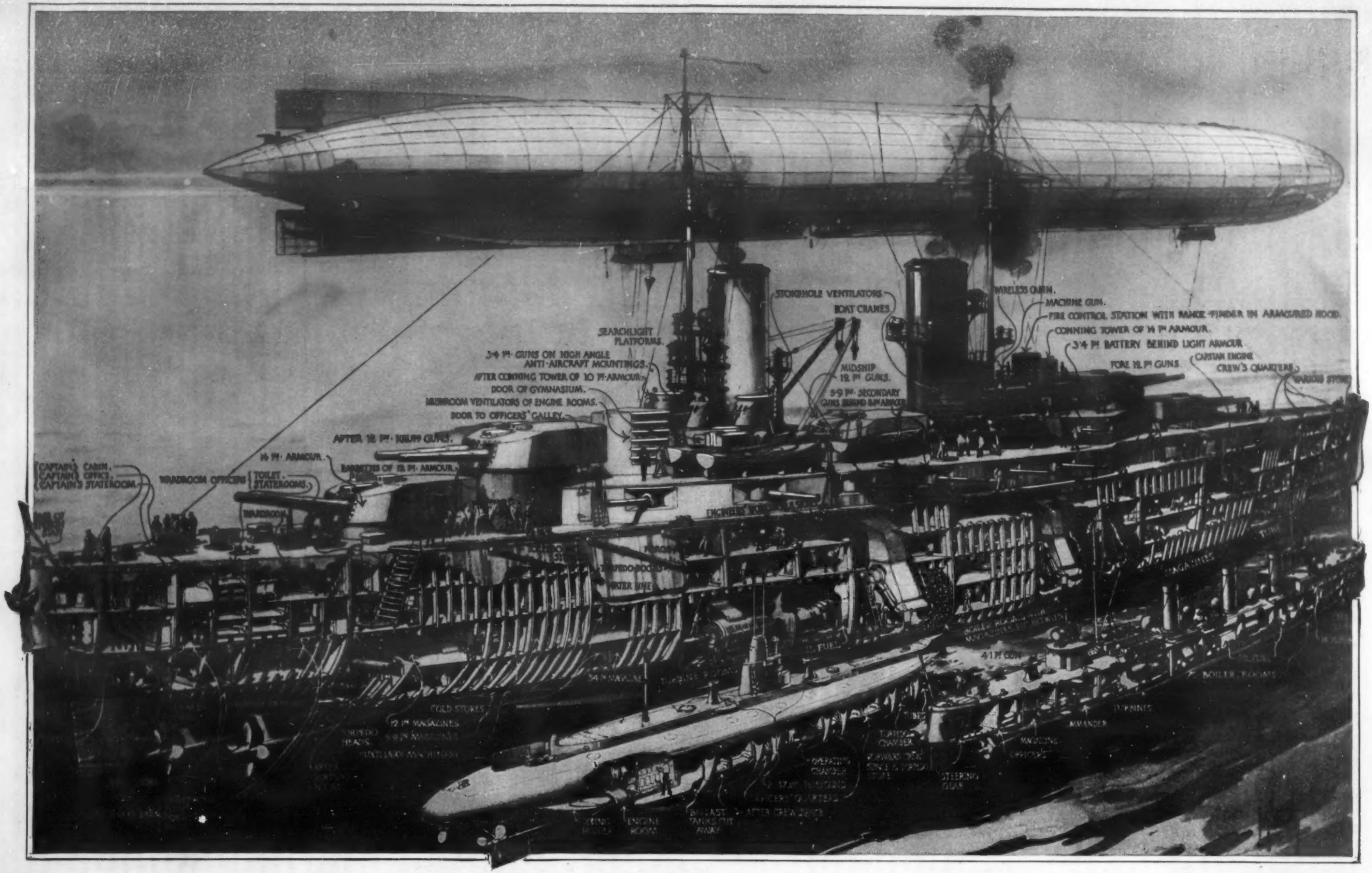
The Condenser Discharge has lately been applied to the testing of muscles. Briefly, the method makes use of a condenser of known capacity, which is charged from the main or from a battery to a constant voltage and is then discharged through a muscle. For muscle testing this method bids fair to supplant other methods, since an exact numerical equation instead of vague terms, is possible. Thus it is possible to determine readily and rapidly the improvement of a patient. The new procedure, however, is still subject to experiment and numerous practical applications before it can take its place in therapeutics.

Use of Aluminum in Germany.—It is learned from *The Electrician* that one result of the war in Germany has been the greatly extended use of aluminum for many purposes. Its use is one of the outstanding features of captured German motor construction, being used for crank cases, gear boxes and even cylinder heads, jackets and shafts. The Germans are said to be able to produce aluminum very cheaply, largely owing to the mining of coal in occupied French territory by forced labor. The cheap production of electricity has also stimulated the development of electric motor vehicles, which are now being run with nickel-iron batteries, owing to the shortage of lead.

The Development of Electric Steel Furnaces.—The *Journal du Four Electrique et de l'Electrolyse* gives some new facts which illustrate the great impetus given to the construction of electric steel furnaces. Since the outbreak of war over a hundred installations are known to have been put in, and the total number in the world now approaches 300, which is about twice the number existing in 1913. The United States is credited with constructing 50 last year and Great Britain with 30 since the war began. Germany is said to have produced 130,000 metric tons of electric steel in 1915 as compared with 90,000 in 1914, and Italy is also making large additions. At a recent meeting of the Sheffield Society of Engineers and Metallurgists, it is interesting to note in this connection, the president remarked that the electric furnace had come to stay, but they must have, by some means, cheaper electric current.

Tungsten as a Battery Element.—The electrolytic behavior of tungsten was treated at length recently in a paper read at a meeting of the American Electrochemical Society. The author of the paper, Walter E. Koerner, carried out extensive experiments and research work under the direction of Dr. C. G. Fink in the research laboratory of the Edison Lamp Works at Harrison, N. J. Perhaps the most interesting feature of the paper was that regarding the use of tungsten in cells, and in this connection the author states that for the construction of a voltaic cell with tungsten as the negative electrode it is desirable to use an electrolyte in which both the tungsten and the anodic reaction products are most soluble. With a sodium hydroxide solution as electrolyte, mercury or silver may be used as positive electrode against tungsten as negative electrode. The emf. of such a combination using mercury is 0.49 volt, with silver 0.69 volt. Preliminary experiments with tungsten both as fused slugs and as metal powder were promising, especially those with the latter. Another series of experiments was made and is still being continued on the use of tungsten in standard cells.

Electrical Treatment of the Wounded.—In a recent number of the *Lancet* Dr. W. J. Turrell describes various applications of electrotherapy at the Radcliffe Infirmary, Oxford, England. One interesting point is the treatment of unclean wounds by ionization, produced either by the application of salt solutions traversed by an electric current, or by means of ultra-violet rays. As is well known, electric currents are now much used in treating certain varieties of rheumatism. Of considerable importance is the application of mild electric "shock" to stimulate the voluntary movements; the treatment is specially efficacious in those cases of nerve shock where the patient is under the delusion that he has lost the power of his limbs. However, the application of electric methods to cases of "shell shock" calls for discretion. In some such cases the patient is not at all benefited and, indeed, exhibits "electrophobia." Currents are also a valuable means of testing the action of various muscles and the powers of sensation, and in producing movements which break down internal adhesions or the binding of scar-tissue. The static machine is considered specially useful in this connection.



A GERMAN BATTLESHIP AND HER PROTECTORS ABOVE, BELOW, AND ON THE SURFACE

The dreadnought "Grosser Kurfurst" shown here, is the last big German ship completed before the outbreak of the war. She is shown with a U-boat and a destroyer of the same period. For the sake of clearness her protective deck and navigating bridges, which are built around the forward superstructure, are omitted. The naval Zeppelin is given in its newest form. She is more than 100 feet longer than a battleship, though her crew numbers barely one-fortieth that of the steel walled leviathan

Aboard the Merchant Submarine "Deutschland"

A Description of the German Blockade Runner Based on a Visitor's Notes

THE policy of secrecy which the owners of the merchant-submarine "Deutschland" have followed was broken recently in the case of the marine artist, Mr. Henry Reuterdahl, when he was permitted to make sketches of the interior, which were worked up by the artist in the very interesting drawing which is shown on the cover of the present issue. The following article is based upon notes taken by Mr. Reuterdahl during his several hours' stay aboard the vessel.

The "Deutschland" is 230 feet in length and is built on the usual system of a circular hull proper, with what might be called an enlarged false hull outside of this. The beam of the hull proper is 17 feet, the full beam of the ship, out to out, is about thirty feet. She is driven by Diesel engines, developing 1,200 horse-power, the engines being six-cylinder, two on each shaft. The speed on the surface is 14 knots, and submerged 7½ knots. The time to submerge from surface conditions is two minutes. According to Capt. Koenig, the total distance run under the submerged condition on the last trip from Germany was 180 miles. It is estimated by American shipping men and naval architects that her cargo capacity is about seven hundred and fifty tons. According to Capt. Koenig, it is 1,000 tons. The entire crew with the officers consists of 29 men. There are three navigating officers, including the captain, and one chief engineer who attends to the submerging of the vessel. The engineers and merchanicians, who come from Krupps in Kiel, are all civilians. The head man from Krupps remained in the United States, thereby indicating that other German submarines are expected to arrive.

The conning tower, according to Mr. Reuterdahl, is superior to the type used on our submarines, and is just the kind which our submarine officers want, but for some reason, cannot get. It carries no loose gear (collapsible surface material) which it is the job of all hands to remove, previous to diving. The "Deutschland", like all the later German submarines, is always ready for submergence. The removal of the repeater compass on the conning tower and the closing of the conning tower hatch is all that is necessary. The chariot-like structure with which we are familiar in the photographs of the boat, serves as the bridge and is high enough to protect a man completely, the bulwark reaching to his shoulders. It holds two men, the officer of the watch and the lookout. There is also a horizontal canvas screen, which can be drawn into place to keep out the spray. All communications from this station are made orally through the open conning tower hatch to the helmsman in the conning tower proper. Except when navigating in harbor, the "Deutschland," like all German submarines, is steered from within the conning tower, where large ports give a clear all-round vision; and the helmsman gets his orders and course from the officer of duty in the conning tower, or on the bridge above, through the conning tower hatch. The German conning towers are large enough to hold four men.

There is complete shut-off between the conning tower and the rest of the ship, when the ship is submerging. The conning tower is cut off by closing the hatch between it and the ship. The speaking tube leading from the conning tower to the man at the wheel has also a cut-off immediately behind the helmsman; hence, should the conning tower be shot away or punctured, two men would be lost, but the rest of the ship would be safe, for it could be steered from the second periscope. It should be mentioned here that a small lifeboat is secured in the superstructure.

The periscopes, of which there are two, are of great power and remarkable clarity, and in these respects are superior to American periscopes. The periscope in the conning tower, at which, usually, the captain is stationed, is hoisted and lowered electrically. The periscope in the operating compartment is hoisted by a chain drive operated by hand.

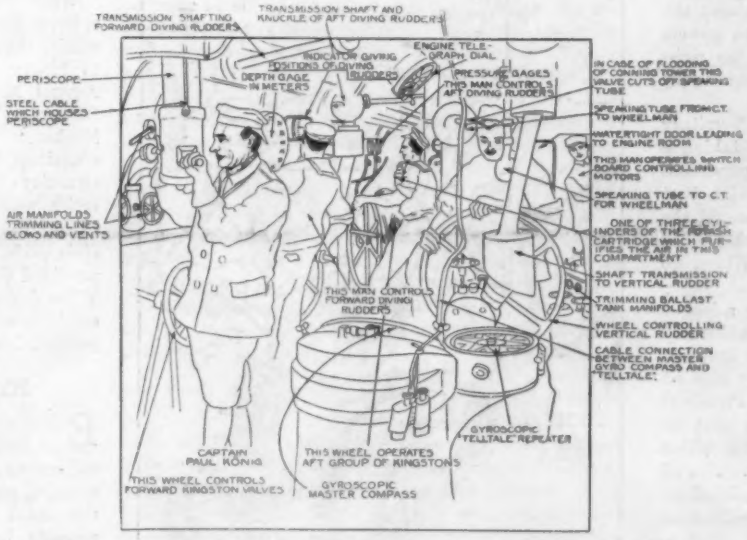
None of our own submarines now in commission has housing periscopes. Mr. Reuterdahl, who had an opportunity to test the "Deutschland's" periscopes, came away with a very high opinion of this feature in German submarine development, stating that the difference in the vision between the "Deutschland's" periscopes and the average periscope on our submarines is something which must be tested to be appreciated. It is natural that, in the art of optical instrument making, the German firms, which for generations have been making a specialty of their work, and have a fine supply of workmen to draw from and a large market to supply, should be able to turn out a product which we cannot match.

Our drawing on the cover, and the key, will together give the reader a realistic impression of the interior of a submarine at sea. The view shows the central operating compartment, with Capt. Koenig at the periscope. Usually this is not the captain's station; but because of the small size of the conning tower, it was impossible to make a drawing showing the captain in that part of the ship; furthermore, such a drawing would not have shown the operation of a submarine. Usually, the engineer, who submerges the vessel, is stationed at the periscope in the operating compartment; but at various times, while passing through, Capt. Koenig would take a look through this periscope, and this is the situation shown in our drawing, the point of view being forward, looking aft. The two men to the left operate the gear which actuates the forward and aft diving rudders. The man at the horizontal wheel to the right is the helmsman, and before him is the gyroscopic compass and the telltale. The operating compartment holds seven men; it is small, comparatively, and is filled with the usual machinery of a submarine, and is indeed in every respect similar to the operating compartment of a German fighting submarine.

The principal arrangements for air control, and the working of the various tanks is about the same as in the American Navy. Those American officers who visited the "Deutschland" were impressed with the high-class workmanship, particularly of the engines and air compressors. There is nothing about the vessel's construction to indicate that it was built during the rush of war time; every part is as carefully finished as though no war existed and there was no call for special hurry.

One of the peculiarities of the construction of the "Deutschland" is that there is no particular ventilation cowl or funnel to supply the air for the Diesel engines. By an ingenious method the conning tower is so arranged that air vents open and close automatically the moment the ship emerges or submerges; and this means that the ship can proceed with the conning tower only two-thirds above water, making use of her Diesel engines. No time is lost in unshipping a cowl, or funnel, previous to submergence.

The deck of the "Deutschland" is absolutely flush and when the ship is at sea it is clear of gear of any kind. At stated intervals along the deck there are sockets for cargo booms; and compressed air motors (movable) hoist the cargo on board. Booms also are attached to the two wireless masts. These are about fifty feet high, are built of wrought iron, and taper off telescopically to the top. The forward mast has a crow's-nest, and a five-stranded aerial is strung between the two masts. The masts, when down, are stowed in pockets on the false deck. They are raised or lowered by means of quadrants at their lower ends, the quadrants being operated by motors. In the bow there is a patent anchor sunk into the plating of the ship. On the port side at the stern there is a smaller anchor. According to Capt. Koenig, the "Deutschland" was constructed in six months' time.


TRANSMISSION SHAFTING FORWARD DIVING RUDDERS
TRANSMISSION SHAFT AND KNUCKLE OF AFT DIVING RUDDERS
PERISCOPE
STEEL CABLE WHICH HOUSES PERISCOPE
INDICATOR GIVING POSITIONS OF DIVING RUDDERS
DEPTH GAGE IN METERS
ENGINE TELEGRAPH DIAL
PRESSURE GAGES
THIS MAN CONTROLS AFT DIVING RUDDERS
IN CASE OF FLOODING OF CONNING TOWER THIS VALVE CUTS OFF SPEAKING TUBE
SPEAKING TUBE FROM C.T. TO WHEELMAN
WATERTIGHT DOOR LEADING TO ENGINE ROOM
THIS MAN OPERATES SWITCH BOARD CONTROLLING MOTORS
SPEAKING TUBE TO C.T. FOR WHEELMAN
AIR MANIFOLDS TRIMMING LINES BLOWS AND VENTS
ONE OF THREE CYLINDERS OF THE ROBASH CARTRIDGE WHICH PURIFIES THE AIR IN THIS COMPARTMENT
SHAFT TRANSMISSION TO VERTICAL RUDDER
THIS MAN CONTROLS FORWARD DIVING RUDDERS
TRIMMING BALLAST TANK MANIFOLDS
WHEEL CONTROLLING VERTICAL RUDDER
CABLE CONNECTION BETWEEN MASTER GYRO COMPASS AND "TELLTALE"
CAPTAIN PAUL KOENIG
THIS WHEEL OPERATES AFT GROUP OF KINGSTONS
GYROSCOPIC TELLTALE REPEATER
THIS WHEEL CONTROLS FORWARD KINGSTON VALVES
GYROSCOPIC MASTER COMPASS

Key to the colored cover showing the interior of the "Deutschland"

Colors Applied to Oil and Gas Storage Tanks

IN further considering the effect of the different types of rays of which light is composed, we find that the calorific or heat producing rays are conducted by painted or finished objects in widely varying degree, according to a paper by Henry A. Gardner, presented before the Annual Meeting of the Pennsylvania State Association of Master Painters and Decorators at Philadelphia. This fact, continues the paper, should be studied by the contracting painter who is called upon to paint the enormous areas presented by metal oil tanks. Such tanks may contain light distillates which, upon becoming warm, produce highly expansible vapors. When black or dark colored paints have been used, rapid absorption of heat takes place, and considerable losses by evaporation are apt to occur. White or light colored paint should therefore, be used for the finishing coats on oil storage tanks. Paints presenting a high gloss are, moreover, less absorptive of thermal rays than those presenting a duller surface.

The following figures are of interest in that they represent the rise in temperature of benzine contained in small tanks painted in various colors (gloss finish), when subjected to rays of carbon arc for a period of 15 minutes.

Color	Rise in Degrees Fahrenheit
Tin plate	19.8
Aluminum paint	20.5
White paint	22.5
Light cream paint	23.0
Light pink paint	32.7
Light blue paint	34.3
Light gray paint	26.3
Light green paint	28.6
Red iron oxide paint	29.7
Dark Prussian blue paint	36.7
Dark chrome green paint	39.9
Black paint	54.0

Since, in the writer's experiments, white paints faintly tinted have given substantially the same heat reflecting properties as white paints, the former should be given the preference, as they are more restful to the eye and more durable on long-time exposure. The same consideration should be observed in the painting of gasholders.

The writer's experiments were made on a series of small cylindrical metal tanks, the exterior surfaces of which were painted in various colors. The tanks contained a standard amount of benzine. Through the pressure opening in the tops accurate thermometers were inserted. The tanks were individually placed in a cabinet containing an open front, and subjected to the rays of a powerful arc light for fifteen minutes. The rise in temperature of the benzine is shown in the above table.

Although plain tin, on account of its smooth, bright surface, gave the best results, it does not constitute a practical finish, as iron coated with tin corrodes on exposure unless protected with paint. Aluminum paint gave very good results, but is not nearly as serviceable as a lead and zinc linseed oil paint.

Tuberculosis in Live Stock

WHILE there has been much agitation on the subject of tuberculous animal products in their relation to human health, and effective measures of protection have been adopted in the shape of the pasteurization of milk, meat inspection, etc., the public at large probably does not realize the seriousness of animal tuberculosis as a source of financial loss to the live stock industry. Cattle and hogs are the most susceptible species and there is abundant evidence of the prevalence of the disease among them. According to the U. S. Bureau of Animal Industry, statistics of tuberculin testing indicate that more than 10 per cent of the dairy cattle in this country are affected with tuberculosis, while in the federal meat inspection 2½ per cent of the beef cattle and 9 per cent of the hogs inspected during the last fiscal year were found to be so affected. The annual losses directly caused by the disease are estimated at $25,000,000. The bureau says that "in the face of growing demands and higher prices for food products, the nation cannot afford to ignore indefinitely so enormous a leakage in its meat and milk supplies." The most important steps in the solution of this problem will be the avoidance of tuberculous cattle for breeding purposes, and the pasteurization of skim milk fed to hogs. Raw skim milk fed to pigs is said to be a prolific cause of the disease in swine.

A Guide Book of New York's Museums

THE American Museum of Natural History of New York, has just issued a book entitled "Guide to the Nature Treasures of New York City." This useful publication sets forth the city's resources in material relating to natural history, with sufficient detail to arouse interest in the exhibits and to enable the student of any particular branch to find what he is interested in. The book deals with the American Museum of Natural History, the New York Botanical Garden, the New York Zoological Park, the New York Aquarium, the Museum of the Brooklyn Institute, the Children's Museum, Brooklyn and the Brooklyn Botanical Garden. It is lavishly provided with pictures, maps, etc.

A Week's Review of the War, February 1st, 1917

By Our Military Expert

DURING the past few days the political features of the war have so far outweighed the strategical and tactical occurrences that a brief review of them is not deemed out of place here.

The first important event was the note of the British Minister of Foreign Affairs, Mr. A. J. Balfour, sent as an amplification of the Allies' reply to President Wilson, naming bases for a durable peace. This note was an addition to what the Allies had previously said in arraignment of the Central Powers, particularly of the Turks and of Turkey's course in the present war. While expressing a desire for peace, Mr. Balfour named three conditions to be fulfilled before such a peace could be expected: first, that existing causes of international unrest should be removed or weakened as far as possible; second, that the aggressive aims of the Central Powers should fall into disrepute among nations and also among their own peoples; third, that behind international law and comity, some form of international sanction should be devised that would halt aggressive tendencies on the part of the boldest nation so inclined.

Here we see the germ of the proposal for a union of nations to enforce peace throughout the world. Carrying this idea further, the President of the United States appeared some days ago before the Senate and made a most notable and unusual address which has attracted the attention of all civilized countries and has brought both criticism and praise for its many suggestions and proposals. His principal thought has apparently been the organization among nations of a league to enforce peace—by some styled a dream, by others something that is practicable. At any rate a few extracts from his speech will show the at least startling nature of his statements; in one place he remarks: "No peace can last or ought to last which does not recognize and accept the principle that governments derive all their just powers from the consent of the governed and that no right anywhere exists to hand peoples about from sovereignty to sovereignty, as if they were property."

The United States purchased Louisiana Territory from France, Florida from Spain, and, after taking a large slice of Mexican territory by force, purchased more territory from Mexico after the war with that country. It also purchased Alaska, has just bought the Danish West Indies and by conquest and purchase, has acquired the Philippines and Porto Rico. Where do we as a nation stand in this matter?

But what would disturb our people most in a league with other nations would be the "entangling alliances" against which Washington cautioned his fellow countrymen; the Monroe Doctrine would apparently also be set aside. But under these two heads the President makes a strong argument—"I am proposing that all nations henceforth avoid entangling alliances which would draw them into competition of power. . . . I am proposing, as it were, that the nations should adopt the doctrine of President Monroe as the doctrine of the world."

Truly this war has brought many surprises—none greater than some of the arguments set forth in the President's address. But whatever criticism may be made of the address and its suggestions, none can deny the world spirit and truly universal patriotic desires of President Wilson. How his views will be ultimately received by the peoples of the warring nations of Europe, when peace is under discussion at the termination of the present struggle remains to be seen; but it can be said definitely that our interests as a world power are such that we must certainly have a voice at least in the political and international questions that will come under discussion. Present information would indicate however, that during the continuation of this war and until a decision by force of arms is reached, no nation will consider presenting its claims or its interests to the judgment of other countries not directly concerned; a league to enforce peace is now only a matter for discussion and not one for too serious consideration.

It can be safely stated, however, and with emphasis and belief, that no such tragedy as the present war will again curse the earth during the lifetime of any of the actors in it. It is only now and hereafter that a true glimpse of the horror and waste attendant upon this struggle can be gained. Already Germany acknowledges a loss of 2,000,000 men with 8,000,000 more that can be drawn upon; but, after all, what is to be gained by the deaths of 2,000,000 men additional when it is already evident that nothing permanent can be obtained by her from such a slaughter? It can be seen, as in the case of the Northern States during the Civil War, that the Entente Allies have the men, the treasure, and the means of blockade to exhaust their opponents.

But little fighting of a serious nature has taken place recently in the various fronts. While in a measure the German lines on the eastern front have been considerably shortened by the advance of Mackensen's forces to the Sereth River River and the consequent straightening of the former Transylvania front, the loss of men and expenditure of material that can not well be replaced must be telling day by day upon the Teutonic resources. This advance to the line of the Sereth in Modavia and Wallachia appears to have been halted as much by the intent to go no further as by the strong resistence now being offered by the Russians and the reorganized Rumanian forces. The fighting is reported as most severe, especially about the confluence of the Putna and Sereth Rivers and along the southern reaches of the latter to its point of junction with the Danube.

On the western front a strong assault by the Germans, estimated to number 120,000 men, was made in Hill No. 304 and Dead Man's Hill in the vicinity of Verdun on January 25th; except at one point where the Germans entered the French trenches, the assault was repulsed with heavy losses to the assailants.

Farther west on the Somme there have been heavy artillery firing and trench raids but no serious fighting. These raids have led at times to very serious results and and to the loss of many prisoners by the Germans; carried out as they have been by both the French and British, they have shown the individuality of the Entente soldiers as against the over-drilled and over-trained Teutons where such individuality has not been encouraged in military work. All operations by the Entente forces on this front are subordinate to the preparations being made for the spring advance when it is expected

General map of the Balkan war area

that decided results will be obtained and possibly that a retreat of the Teutons out of France and Belgium may be forced. At present everything points to the British as the principal actors in the first efforts; it would be most natural that such should be the case along the front now occupied by them in France.

The Germans claim great advantage in the recent assaults upon the Russian lines on the Riga front, where they claim to have driven back the Russians for some miles in the vicinity of the Aa River and Tirul swamps. If true, this has removed the danger to Mitau which has been made a great depot for supplies for the German troops on that line. Farther south the Russians have had decided successes on the Bukowina-Rumania fronts, having secured much booty and a number of prisoners. But little in the way of military operations should be expected, however, until the severe winter weather now reigning in those regions has moderated.

The best use to be made of the forces operating from Saloniki has given rise to a good deal of discussion as to the results that may be obtained, in view of the Rumanian disaster. But, as matters now stand in the Balkans and, in a larger view for the Teutonic forces, an advance by this Saloniki army is most important. The Entente Allies having reached Monastir in Serbia and having advanced along the Vardar valley, it is essential first, that Serbia be regained and also that the railway from Belgrade through Nish, Sofia and Adrianople to Constantinople shall be cut and held. To understand this some knowledge of Germany's ultimate plans must be kept in mind. She is not so much interested in holding Belgium, Poland or parts of France as she is in extending after peace her influence to build a great central empire in Asia Minor—the empire that shall extend from the Baltic to Bagdad. And to cut and hold the Orient railway is to sever the spinal column of this plan. It is true that, even though this road should be cut, Germany by her victories in Rumania would have routes to Constantinople via Rustchuk to Varna and thence by the Black Sea or even by Cernavoda to Constanza and thence by sea. But these routes would be only veins of the system; the main artery is the present railway and its retention means success—its destruction means failure.

That Germany's intentions regarding Asia Minor are well recognized by England is shown by the continued efforts of the latter to advance up the Tigris to Bagdad. Even now her forces are again at or near Kut-el-Amara, the scene of General Townsend's surrender to the Turks in 1915; and it is fairly certain that her objective is the capture of Bagdad itself.

If in 1917 the Saloniki forces can cut the line to Constantinople and the British prove strong enough to take Bagdad, the Allies will have countered heavily against the successes of the Central Powers in 1915 and 1916.

Moisture and Dust Resisting Properties of Painted Cement

PORTLAND cement is used for numberless types of construction, from the concrete factory to the stucco dwelling. Its strength and durability are, however, offset by its unpleasing appearance, especially during stormy weather, when it absorbs large quantities of water and becomes mottled and streaked. At such times the interiors of concrete buildings are apt to become damp and cold. The rough exterior surfaces will receive and retain particles of dust and soot deposited from the air.

When paint is applied to a concrete structure the exterior pores are filled, and a smooth, rubber-like film results that prevents the admittance of rain, according to Henry A. Gardner, speaking recently before the Annual Meeting of the Master House Painters' and Decorators' Association of the State of New York, at Rochester. This alone, continues this authority, should constitute sufficient reason for painting cement constructions in every locality. The dust resisting properties and ornamental character of painted cement should be the further consideration wherever there is civic pride. Fortunately, paint will wear well on cement provided the paint is applied when the cement is dry. When damp the cement should first be treated with zinc sulphate solution. Moreover, the same paints that give good surface on wood may be used successfully on cement.

Birth Statistics in the United States

EVER since it was established on a permanent basis, in 1902, the U. S. Census Bureau has made annual collections of mortality statistics from a steadily increasing area, which now contains about 70 per cent of the total population of the United States. Until recently, however, it has not been possible to establish a corresponding registration area for births, because very few states have maintained reliable birth registration systems. Such an area has now been created, embracing the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Michigan and Minnesota, and the District of Columbia. Athough this region represents barely 10 per cent of the territorial extent of the continental United States, its population is about 31 per cent of the total for the country. The director of the census states that birth statistics relating to an area having a population of such size and heterogeneity will be of great value and significance. Besides the general statistics, data will be gathered concerning the white and colored races separately.

Transmissibility of Pellagra

DR. JOSEPH GOLDBERGER, of the U. S. Public Health Service, has recently reported the results of experiments on the transmissibility of pellagra in the human subject. The belief that this disease is communicable is widely held, but is not supported by trustworthy evidence. Experiments on monkeys have been inconclusive, and accordingly Dr. Goldberger determined to undertake tests on man himself, and this was made possible by the coöperation of sixteen volunteer subjects, mostly physicians and scientific men. One of them was a woman. Various methods of attempted inoculation were employed, and various forms of material from pellagra cases were used. During the period of from five to seven months between the experiments and the time of the report none of the volunteers had developed evidence justifying a diagnosis of pellagra. The experiments, says the author, furnish no support for the view that pellagra is a communicable disease; they materially strengthen the belief that it is a disease essentially of dietary origin.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Battle-Cruiser Controversy

To the Editor of the SCIENTIFIC AMERICAN:

Your patriotic interest in the welfare of our Navy and your well-known desire to arrive at the truth in engineering matters prompts me to lay before you and your readers the main facts of a most extraordinary situation, involving our Navy Department and its decision to equip our battle-cruisers with the "electric drive" instead of with the "geared drive." For those unfamiliar with these terms it may be said that with the electric drive the power of the steam turbines or engines is transmitted to the propeller shafts by first converting it into electricity in dynamos and then reconverting it into mechanical power in electric motors attached to the propeller shafts. With the geared drive the power of the turbines is transmitted to the propeller shafts directly through mechanical gearing. England and Germany have decided the question against the electric drive, and the geared drive has been used by the British Navy and merchant marine in a vast number of ships including battleships of double the power of ours and battle-cruisers of 165,000 horse-power.

Months ago at conferences held at the Navy Department the shipbuilders forcibly pointed out to Secretary Daniels that if geared drive were adopted in place of electric drive there would be a saving of about $200,000 in cost and about 300 tons in weight on each battleship with the same structural protection.

They also pointed out that the advantages of the geared drive would be very much greater in the case of the battle-cruisers. In these vessels at least $1,300,000 saving in cost and over 1,000 tons saving in weight will result with a better fuel economy and with better protection to the vitals of the ship. This better protection is secured by placing all the boilers below the protective deck in the same spaces occupied by the turbine generator sets in the Department's plan and by keeping the underwater protective bulkheads practically unchanged. The additional space required by the electric generating plant is so great that it necessitates placing half the boilers on an upper deck exposing them to shell fire and requiring seven smokestacks instead of the three required with all the boilers below.

The shipbuilders also pointed out that the "Jupiter," a small vessel of only 6,500 horse-power, was not a safe criterion to justify installing this drive in all our capital ships, including the 180,000 horse-power battle-cruisers, without waiting until at least one of the three large battleships already contracted for has been tried.

Mr. Luther D. Lovekin, Chief Engineer of the New York Shipbuilding Company, wrote a forceful letter to the Secretary advising against the electric drive in these ships, and stating that the total weight of the ship would be over 1,000 tons more than if the geared drive was used. The Fore River Company, in a letter attached to their bid, formally stated that with the geared drive there would be a saving in weight of at least 1,000 tons and a saving in cost of at least $1,300,000, and that the boilers could all be placed below the protective deck without impairing the protection provided against torpedo attack.

In the case of the scout-cruisers, vessels of 90,000 horse-power, the Navy Department did not even consider electric drive machinery, but designed them with geared drive and frankly stated that because of the space required and the weight it was not possible to use the electric.

On December 19th last I wrote to the Secretary drawing his attention to the views of the shipbuilders and saying that my own investigations had led to the same conclusions, but although this letter related to a matter of great engineering importance and involved ships costing about two hundred million dollars, I have never received any reply—not even an acknowledgment.

When these battle-cruisers were being first laid out, the engineers in the Bureau of Steam Engineering of the Navy were of the opinion that the electric drive would be lighter and would cost less than any other kind. In fact it was their belief that no other form of drive could be installed in the space allowed for boilers and machinery. The Engineering Staff of the Bureau is small considering the volume of work it must handle, and it was quite impossible for it to work out two complete sets of plans for comparison. The result was that the Bureau worked out one complete set of plans only, based on the electric drive and recommended their adoption. The electric company that is active in advocating the electric drive has admittedly not laid out a geared turbine design for comparison. I quote from a paper by Mr. Emmet, the expert of this company, recently published in the *Electrical World:*

> A just comparison of this method with the electric equipment proposal would require a complete design and analytical study of the geared equipment and its performances. The writer has not made such a study in the case of these vessels, therefore no exact figures can be given.

The shipbuilders, on the other hand, did independently lay out complete designs, covering both the electric drive and the geared drive and studied very carefully the questions of weight, cost, economy and protection involved in both systems, and as a result they strongly recommended the adoption of the geared drive. The engineers of the Navy Department and of the electric company, although they have not worked out the comparison for themselves, content themselves with saying that the estimates prepared by the shipbuilders are not based upon fair comparisons. The Department has been endeavoring to envelop the whole matter in mystery, as if it was about to steal a march on the foreign navies, particularly the British.

What the British think of these proposed electrically driven battle-cruisers is indicated by an article which appeared recently in the *Engineer*, published in England. This prominent technical journal, referring to the use of electric propulsion in our ships, says:

> Without presuming to decide on a question which concerns the American Naval administration alone, it is difficult to appreciate the motives which have led the Navy Department to insist on so many new and untried features in a type of warship in which, perhaps more than in any other, a high sustained speed and tactical qualities are the prime desiderata. An internal arrangement which leaves half the boilers with practically no protection against shell fire would scarcely commend itself to those who have to take the ship into action.

Many engineers of great prominence, including several members of the Naval Consulting Board have written to the Secretary, some advising against the adoption of the electric drive and all telling him that he is making a mistake in deciding this momentous question without seeking the opinion of outside engineers. These appeals have thus far been in vain. What is asked of the Navy Department is that it shall do what any private company would do in a case of such great importance, viz., secure the independent opinion of those who have had the greatest experience with the different kinds of machinery proposed. The New York Central and New Haven railroads did this when they created a board of engineers to decide on the electric features of the Grand Central Terminal. When the Panama Canal was built the important questions were referred to a board of distinguished engineers and yet the amount of money involved was less in the case of the Grand Central Terminal and probably not very much greater in the case of the Panama Canal than the cost of the battleships and battle-cruisers under consideration. The Department not only declines to seek such opinion, but has made it plain that any suggestion or interference from outside is unwelcome.

In a letter to Senator Swanson, of the Senate Naval Committee, dated December 15, 1916, Mr. S. S. Wheeler, President of the Crocker-Wheeler Company, electrical manufacturers, protested to Senator Swanson against the adoption of the electric drive because of the objections stated by the shipbuilders, and because as an electrical engineer he believed that the results would be unsatisfactory. In this letter he urged the reference of the question to a board of impartial engineers. This letter was referred by Senator Swanson to the Department and was replied to by Admiral Griffin, Chief of the Bureau of Steam Engineering, in a letter to the Chairman of the House Naval Committee, dated January 5, 1917.

In his reply, Admiral Griffin says that a ship equipped with the geared turbine drive will require much greater weight of steam piping, valves, etc., and about three hundred tons of additional armor, and if this extra weight is taken into account the net saving over the electric drive will be only about three hundred tons instead of 1,000. On applying to the shipbuilders, however, they tell me that Admiral Griffin is mistaken, that in the Fore River plans there is practically no additional armor required, that in their estimates all the points mentioned by Admiral Griffin have been taken into account and that they are confident of saving at least 1,000 tons.

Admiral Griffin says that if the cost of this extra armor (300 tons at about five hundred dollars per ton) is taken into account there will be no saving in cost. On inquiry, the shipbuilders reply that their estimates of cost are correct notwithstanding what Admiral Griffin says, and that they are confident of saving at least $1,300,000 in cost. The president of the Fore River Co. at a hearing before the House Committee a fortnight ago, at which I was present, stated that he would *guarantee* a saving of $1,300,000.

Admiral Griffin states that:

> No other type of machinery than electric can be installed in the space available, and no other type can give the under-water protection to the ship that is possible with the electric drive.

How can this first statement be true if it be a fact that with the geared drive all the boilers can be placed below the protective deck, whereas with the electric drive, because of the additional space required by the electric generating plant, half the boilers must be placed above? It is difficult to imagine what Admiral Griffin could have had in mind. So far as the under-water protection of the ship is concerned, the shipbuilders assure me that there is no difference between the two forms of drive, that one gives as good under-water protection as the other. Looking at the plans it is difficult to see any material difference in this regard.

In their efforts to set the Department right, the shipbuilders and the turbine people have incurred criticism and are being unjustly charged with motives which have no basis of fact. It is being said that the shipbuilders would prefer the geared drive because they would manufacture it themselves and make a profit. The contrary is true for the following reasons: If the shipbuilders put in the geared drive, they will have to guarantee the performance of the ship as a whole, whereas if they put in the electric drive the electric company manufacturing it will assume the responsibility for this machinery, as was done in the case of the battleships recently awarded, the construction of these ships being provided for in a three-cornered contract, which is a most objectionable one for the Government to enter into.

Again, in the case of the battleships the Government allowed the shipbuilders 10 per cent upon the cost of the electric drive purchased from the electric company, which is quite as much profit as the shipbuilders could hope to make on the geared machinery. The shipbuilders do not in any event want the business of building the machinery of these big ships, because of the responsibility; they would prefer to reserve their machine shop capacity for other work of a more profitable nature. They do not even want to build the ships, but feel that patriotism compels them to do so. The Fore River Company has offered to do this work at a price that will yield a profit of less than 10 per cent, or "*on any basis of profit that the Federal Trade Commission appointed by the President shall consider fair.*"

The eminent engineers who are urging the appointment of a board of inquiry are not seeking to take from the Secretary his power of final decision. They are only seeking to have him advised in this highly important matter by experts representing no interested party. Such a board could very properly be selected by the "Naval Advisory Board" which itself is composed of men selected by the great engineering societies.

It is to be hoped that other engineers and all who are interested in our Navy and approve of this course will communicate with the Administration or the Naval Committees of the House and Senate, and urge that the question be submitted to such a board and that its members be selected by the "Naval Advisory Board."

CHAS. G. CURTIS.

February 1, 1917.

In the Cause of Science

To the Editor of the SCIENTIFIC AMERICAN:

The undersigned Committee on Engineering of the General Committee on Research of the American Association for the Advancement of Science feel that it is timely to issue the following appeal to the industrial research laboratories of the country.

In the course of work done in the numerous industrial laboratories of America, many physical and commercial constants and data of great scientific interest and value are doubtless arrived at, and which may, for a certain period of time, constitute an asset of considerable commercial value to the particular corporations in question. During this period, everyone recognizes the proprietary right of the industrial laboratories to the retention of this information.

A time frequently arrives, however, when such scientific information loses its commercial value (often by being duplicated in other laboratories), and just at this point we wish to impress upon the industries their obligation to enrich scientific literature with the facts established and data secured, which might otherwise be lost or forgotten.

Some of our industries have been reproached with the suspicion of acting as sponges, in that they absorb an immense amount of useful information from scientific literature without giving any return in kind. This suspicion would be entirely removed, if from time to time scientific information which has ceased to be of commercial value were contributed by them to its appropriate channel and thus became available to all scientific workers throughout the world.

If any doubt exists as to the appropriate channel for the publication of such scientific data and communications, the secretary of the A. A. A. S., Dr. J. McKeen Cattell, Garrison-on-Hudson, N. Y., will be glad to act as intermediary and to forward such communications to the proper scientific body.

A. E. KENNELLY,
J. W. RICHARDS,
A. SAUVEUR,
A. N. TALBOT,
C. T. THOMAS.

Where Science Joins Hands with Art

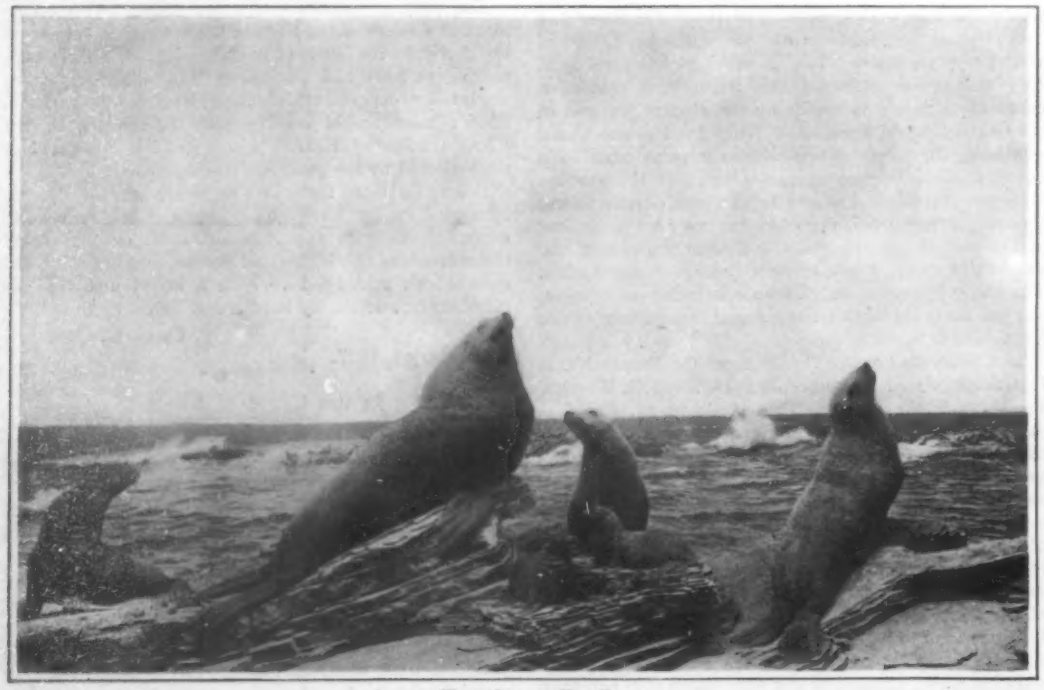
The Modern Taxidermy as Revealed in San Francisco's Great New Museum

By Samuel Hubbard

IT has remained for the Far West to speak the last word in museum construction and the installation of habitat groups. The California Academy of Sciences, whose new museum in Golden Gate Park, San Francisco, was opened to the public in September, 1916, has now the most up-to-date museum in the world and the most beautiful and artistic mammal groups ever created. This is the opinion not only of enthusiastic supporters of the institution, but of scientific museum men as well, men who are unprejudiced and who are entirely competent to judge of such matters.

Like every other art, science and craft, the art of taxidermy has been undergoing the usual process of evolution, and has been steadily seeking better and higher methods of expression. As in all other matters dealing with science and art our inspiration comes from Europe. There most of the first art galleries were discarded palaces and most of the museums were modeled after them. It has now come to pass that buildings which were designed originally for human habitation, with the customary side windows and cross lights, are not by any means ideal either for the exhibition of pictures or for museum purposes.

At home with the California Leopard Seal



How the sea lion lives

This change in ideals has come about very gradually for museums, especially in the older centers, are well established institutions and are managed by exceptionally conservative people. Again, when a museum has once been built, it is very expensive and often impossible to change, hence the management has perforce to continue in the old way.

Everything has a beginning, so it may be of interest to relate briefly the apparently trivial circumstance which has in effect relegated nearly all the museums of the world to the scrap heap. An English gentleman, walking in his park one spring morning, discovered a pheasant's nest. He was so struck with the beauty of the sight, the brown eggs snuggled in the green grass and surrounded by wild flowers, that the desire came to him to have others enjoy it as well. So he determined to reproduce the scene just as it was before his eyes. He went to London and found a woman who was skilled in making artificial flowers. He secured an artist to paint the background and a taxidermist to mount the birds. The scene was installed in a glass case and was then presented to the British Museum. It won such instant recognition and approval from the public that the museum staff began making similar bird groups in a small way.

Then the plan was taken up by the American Museum of Natural History in New York City. They improved and enlarged on the idea and began making larger groups, such as the flamingo colony, the white pelican rookery, and many others. Their building was not adapted to groups of this character for the reason they could get no top light. They were therefore obliged to put the groups in a side gallery and light them artificially. Mammal groups were attempted; but usually, as in the Field Museum in Chicago, they were placed in the middle of the gallery without a painted background, hence the illusion was destroyed.

The California Academy of Sciences is managed by a board composed of the leading business men and scientists of San Francisco. When the great earthquake and fire of 1906 completely destroyed their collection and building, the disaster only brought about a resolve to build bigger and better than before. So quietly and unostentatiously was this work done that the public generally believed the Academy had gone out of existence. And even yet the people are not fully aware that the Academy's exhibit of habitat groups surpasses that of any other museum in the world.

The board secured the services of Mr. John Rowley, as curator of mammals. His 18 years' training in the Museum of Natural History in New York especially fitted him for the task. A site was then secured in Golden Gate Park where complete isolation from fire hazard was obtained, as well as ample room for future expansion. Plans were then drawn, by a well-known firm of architects, for a building without side windows and lighted only by top light. One wing of the building has now been completed, some fifteen habitat groups of mammals and birds have been installed, a notable collection of Indian ethnological material has been loaned and installed, and the building has been thrown open as a free museum.

Owing to the fact that the larger California mammals are fast approaching extinction, on account of the encroachments of civilization, it was determined to collect them first. In Mammal Hall there are spaces prepared for eleven large groups. The cases in which the groups are installed average twenty-five feet long by twelve feet deep and twenty feet high. They are a part of the building and are lighted only from the top. The background for the oil painting is curved and plastered. It is 20 feet high and is 40 feet long around the curve. The front of each case is protected by a large pane of plate glass 10 by 15 feet, which is dust tight.

The following large groups have already been installed:

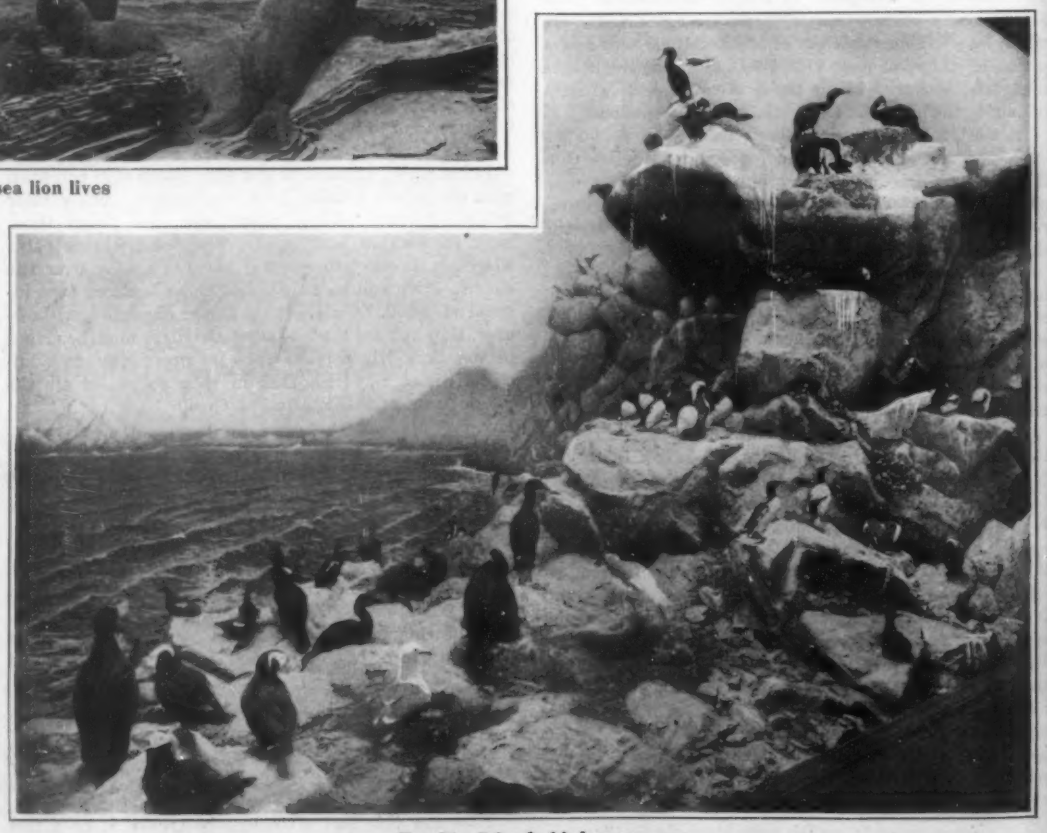
California or dwarf elk	Kern County
Northern black-tailed deer (summer scene)	Mendocino County
Mule deer (winter scene)	Siskiyou County
Antelope (fall scene)	Modoc County
Big horn sheep (desert phase)	Riverside County
Steller's sea lion, Ano Nuevo Rookery	San Mateo County
California sea lion, Santa Cruz Island	Santa Barbara Co.
Harbor or leopard seal, Cypress Point	Monterey County

Smaller groups:

Cougar's Den	Coyotes' Den
Black Bear's Den	Coons' and Skunks' Dens

The birds have not been overlooked, for in a wing called Bird Hall there are the following:

Farallon bird rookery	Donated by William H. Crocker
San Joaquin Valley summer bird group	Donated by Joseph D. Grant
Desert bird group	Donated by William B. Bourn



Farallon Islands bird group

California valley elk group

Birds from the San Joaquin Valley

The birds and animals were all collected and mounted by the museum staff. They also made all the accessories, such as rocks, snow, flowers, grass, moss, leaves, trees and shrubs. These minor details require an amount of study, labor and painstaking care that can scarcely be appreciated except by those familiar with the work. The groups cost on an average about three thousand dollars each. The work began under former Director Leverett M. Loomis, and is being completed by the present director, Dr. Barton Warren Evermann.

It has been evident for some time past that the old style of exhibiting animals and birds on wooden stands in glass show cases had become obsolete. The public gets a confused idea of a mass of material without carrying away any distinct impression. By the group method, however, a distinct picture is created which is so impressed on the mind that it is not easily forgotten. Hence the spectator is not only delighted by a scene of artistic beauty, but is also unconsciously instructed.

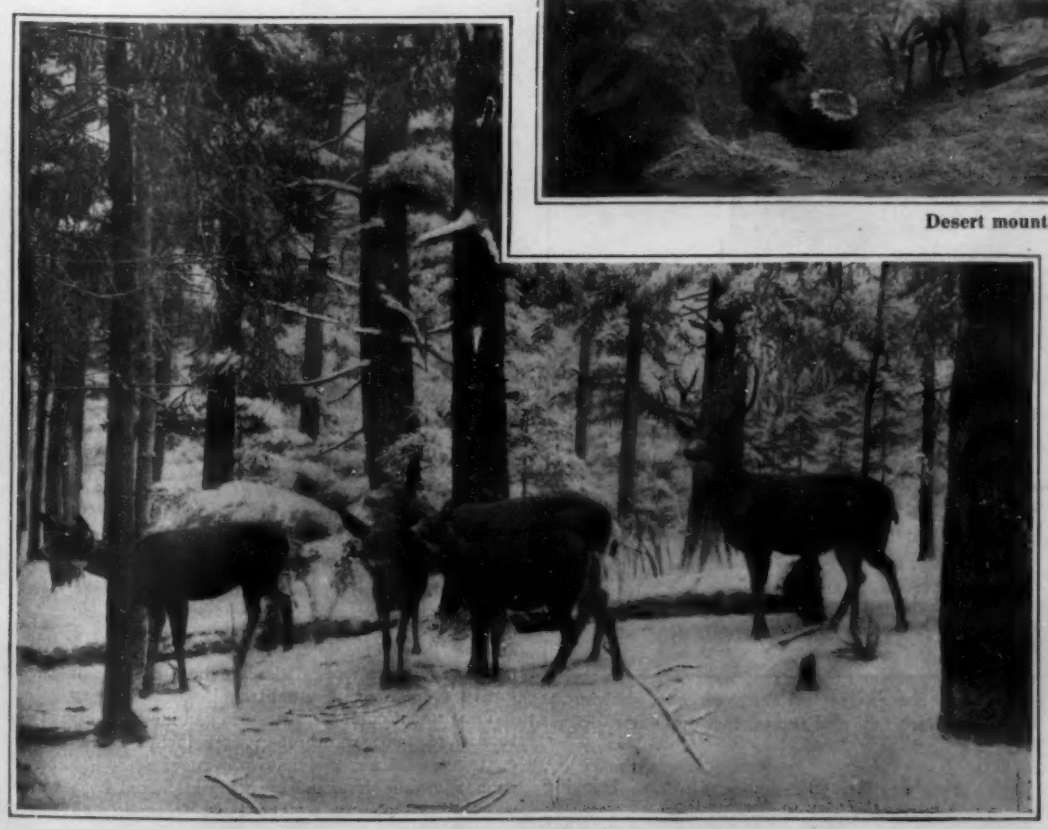
There is no limit to the field these groups may occupy. They may be used not alone for natural history, but for ethnology, for historical subjects, for agricultural scenes, and for illustrating mechanical processes. It is not venturesome to prophesy that the museum of the future will be planned almost exclusively for habitat groups, that it will have no side windows, and that exhibits of this character will put it on a higher plane, where it will increase in popular regard and become an essential factor in the community's educational system.

Increased Amount of Fog a Feature of Last Year

RESULTS obtained by the United States Bureau of Lighthouses by tabulating the figures from the various fog-signal stations throughout the service show that the average amount of fog was greater during the fiscal year 1916 than during the preceding year, except in the lake districts where the amount varied very little from that recorded in the fiscal year 1915.

The greatest amount of fog was observed at San Francisco Light Vessel, Cal., in the eighteenth district, aggregating 2,221 hours for the year, or approximately 25 per cent of the time. The highest record on the Atlantic coast was that at Egg Rock, Me., in the first district, where 2,043 hours of fog occurred, equivalent to about 23 per cent of the year. The most dense fog in the dog days is found along the coast of Maine, New Brunswick and Nova Scotia. During this season the fog is so heavy that it is sometimes impossible to distinguish persons or objects twenty-five feet away.

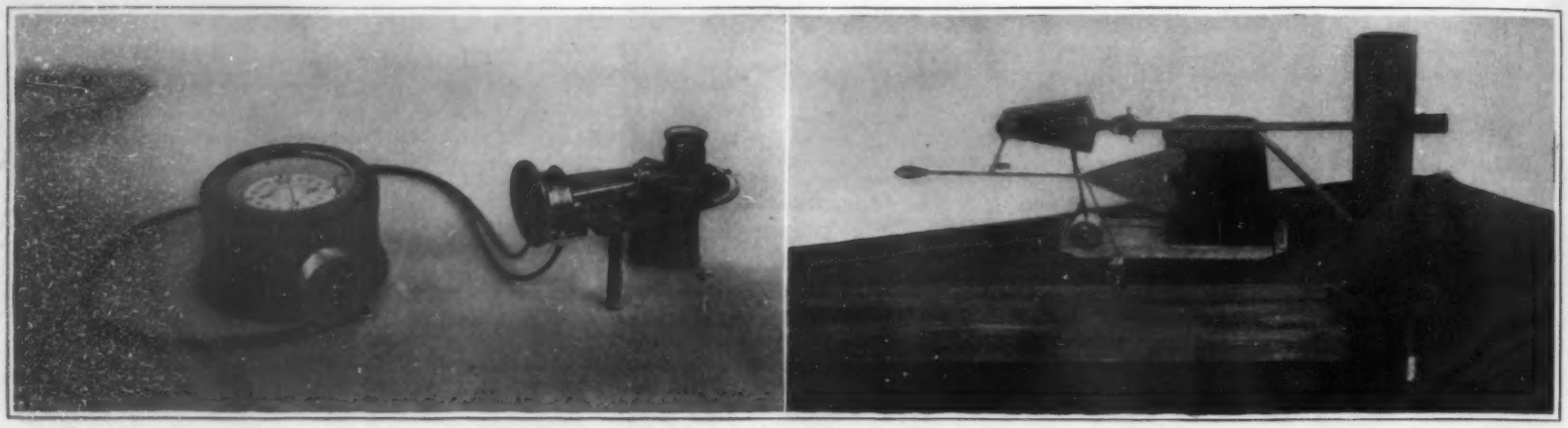
Desert mountain sheep group



Mule deer in a painted winter

The Current Supplement

THE diversified character of the contents of the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT will be greatly appreciated by all who like to keep themselves informed on general scientific subjects, as it contains articles covering a wide range of subjects. *The Contributions of Geodesy to Geography* shows that the determination of the shape and size of the earth, and the location of places on its surface, referred to fundamental planes, are the geodesist's principal contributions to geography. *Anomalies in the Animal World* is the first of several papers that will appear from time to time in the SUPPLEMENT, and the present article deals with flying mammals, flightless birds and other curious forms. These papers will be found of particular interest, discussing as they do biological questions that have heretofore been generally overlooked. The papers will be fully illustrated. *Promoting Our Supplies of Food Fishes* tells of a few things the government is doing for the benefit of both the producer and the consumer. It is accompanied by a number of excellent photographs. *Capillary and Electrocapillary Chemistry* is a valuable survey of the more important phenomena and their technical applications, and involves a subject of wide interest that is of particular value to many outside the ranks of the chemical profession. *A Study of Wave Motion* is directed to discovering means for counteracting the rolling of ships. It is accompanied by diagrams and illustrations. There is a short article giving important facts relating to *The Total Solar Eclipse* of June 8, 1918, and it is accompanied by a chart that shows the path of the moon's shadow across the United States, with the standard times of beginning of totality, the duration of totality and altitude of the sun. The intensely interesting series of lectures on *Vibrations, Waves and Resonance* is concluded in this issue.



Two aeronautical instruments that simplify the aviator's task: At left, a Sperry synchronized drift set; at right, an incidence indicator

Aeronautical Equipment Which Lightens the Work of the Aviator

SCIENTIFIC aviation accessories, showing the progress made in aerial navigation equipment from the days when an altimeter was the only instrument on a flying machine to the present-day equipment of automatic pilots, synchronized drift sets, azimuth stabilizers, incidence indicators and other apparatus found on many aeroplanes are to be seen at the Pan-American aeronautical exposition now being held at the Grand Central Palace, New York City.

The visitor to the exposition is immediately impressed with the fact that the aeronautical engineers have been hard at work in designing apparatus that assure every pilot the utmost safety under all conditions of aerial navigation. Since the equipment can be installed on any type of aeroplane or seaplane, flying may be made easier and more comfortable, as well as safer, for whoever sits in the cockpit with hands on the control levers.

The relief from physical and nervous strains guaranteed a pilot using up-to-date apparatus is as important as the selection of a modern machine in preference to an old-type aeroplane. Take the Sperry synchronized drift set for example: By using this instrument an aviator can fly directly to the point of destination regardless of whatever side winds are encountered. Moreover, the correction for velocity and direction of air currents is done without making mathematical calculations.

Some apparatus never before exhibited publicly are being shown at the exposition, among them an azimuth stabilizer, stallomometer for warning against stalling, a chart holder and inclinometer, which is used for indicating the fore and aft positions of an aeroplane with reference to the horizontal.

Two views of the compass that has been designed especially for the use of aviators

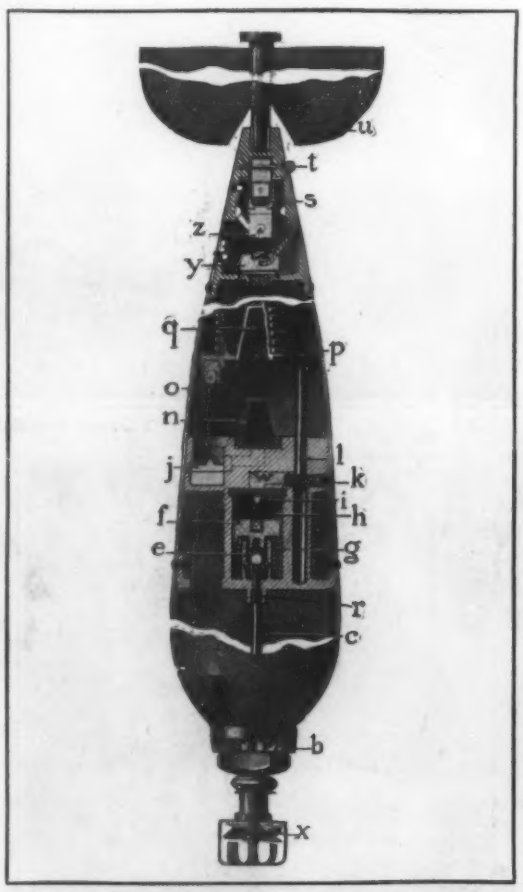
An Aerial Torpedo That Makes Bombardments from the Air More Effective

TESTS recently conducted at the Mineola flying grounds on Long Island with a new form of aerial torpedo have gone far to disprove that aerial bombardments are more or less a highly spectacular form of pyrotechnics It is too often forgotten by military men and others who rush into harsh criticism of the effectiveness of aerial bombardments in the present war that the bombs employed by the airmen thus far have been either of an improvised type or at best of poor design.

Perhaps the main fault with present-day aerial bombs is that they explode on contact, so as often as not the bomb buries itself in the earth for a considerable distance before it explodes. Thus the explosion meets with the soft, yielding earth, and little of the intended destruction is accomplished. Most of the European belligerents are employing standard artillery high-explosive shells which are fitted with a special tailpiece. The latter causes the contact denotating device to become alive only after the bomb has been released, but bombs of this sort are capable of inflicting extensive damage only if they happen to strike a substance that offers considerable resistance.

In the United States of late a number of aerial torpedoes have made their appearance, and much interest is being displayed in some of these by our Army officials. One of these torpedoes is illustrated in cross-section in the accompanying drawing, and its operating features may be taken as more or less standard for others that are also time controlled. The main advantages of this form of aerial projectile are that it is safe to handle, that its destructive power extends over a considerable zone, and that it is time-controlled.

In many respects the present aerial torpedo can be compared to the standard field-gun shell. For instance, the aviator calculates the distance he is from his target and sets the nose of the torpedo opposite the graduated ring *b*, which corresponds to this distance. The bomb is then released; and the momentum of the first 50 feet of descent fires the auxiliary primer *n*, this being accomplished by the rotary motion of the propeller *x*, mounted on the shaft *c*. The method by which this is brought about is ingenious. The propeller shaft, by means of the thread *r*, frees the spherical end of the stirrup cup-spring *e*, the arms of which have until now been engaged in a recess in the cylinder wall. With nothing to hold it back the spring *g* forces the plunger *f* upward, bringing its primer *h* in contact with the firing pin *i*.



Sectional view of a typical aerial torpedo, showing the time-fuse and the contact detonator

The flame that results is carried through the vent *w* to the cylinder of plaited rope powder composition *k*. This in turn burns away, releasing the plunger stem *l* which is forced by the spring *p* into the chamber below. It is then and for the first time that the picric acid booster charge at *q* is incased around the denotator *n*, through the action of the spring *p*. Meanwhile the primer *o* has been brought in contact with the firing pin *j*, and the flame is carried to the detonator by means of the long or shortened time trains determined by the setting of the nose of the torpedo. The explosion of the main charge follows as soon as the flame reaches the detonator.

Now supposing the aviator misjudged the distance of the target, so that the setting of the time fuse would bring the explosion some time after the torpedo had reached its mark, which would probably mean that the torpedo would fail to accomplish its mission. It is to meet just such a condition that the present torpedo is also equipped with a contact detonator or impact detonator located in the rear of the stem. The firing pin is seen at *z*, the primer at *s*, the safety wire at *t*. The force of the detonator explosion is communicated to the main charge, and so at its worst the torpedo is as effective as the best contact exploding bomb. Lastly, *u* is a steering vane for guiding the torpedo toward its mark.

The torpedoes tested by the Army officials at Mineola are known as the Barlow torpedo, and are made at the Frankford Arsenal. Quite naturally the details of this torpedo are being carefully guarded, although in its main essentials it probably follows the design of the torpedo described in the foregoing.

Aviator's Compass Which is Visible at Night by Its Own Light

A POCKET compass which is unusually accurate because the magnetic dial is suspended in a liquid and which can be read at night by its own light, has been recently introduced for the use of aviators, sportsmen, military organizations, and everyone requiring a small compass that is dependable under all conditions.

A knowledge of navigation is not essential for laying a course with this compass. The first step is to set the instrument upon the chart at the spot indicating the user's location. The zero mounting of the outer ring, in line with the arrow point on the glass crystal, should point toward the north or top of the map. Any course desired (or the direction to be traveled in going from one location to another) may be found by elevating, to an angle of 45 degrees, the arm of metal attached to the outer ring and then sighting over its top and the niche in the magnifying glass bezel ring to a pin stuck in the chart at the point of destination. Such a process illustrates one important advantage of this compass over similar instruments, namely, that parallel rules for sighting are unnecessary and may be dispensed with.

In order to travel from any location to a particular destination it is essential to apply the magnetic variation. With other compasses it is necessary to add or subtract this magnetic difference, depending upon whether the variation is westerly or easterly. Doing so gives the magnetic head to be traveled, read on the center dial in the bowl. In using this compass, however, both adding and subtracting are done away with. It is merely necessary to move the lubber's line, indicated by a white line and arrow painted on the crystal, to the point of destination. This line becomes the lubber's line to be followed in actual travel.

The present compass, measuring an inch and a quarter thick and two and three-quarter inches in diameter, contains no steel except that in the magnet, so the needle cannot become deranged by being attracted by another part of the compass. The bowl is made of bronze and painted, while the fittings are of brass. A magnify-

(Concluded on page 161)

Using Electric Lift Bridges to Reduce Trucking Distances on Freight Platforms

BY introducing electrically operated lift bridges which span a group of tracks at two points, the handling of freight at the local freight terminal of the Atchison, Topeka & Santa Fe railroad at Los Angeles has been simplified to a great extent. These bridges, which effect a saving in trucking distance of hundreds of feet per trip for the electric tractors and trailers, present an interesting departure in freight house operation.

The freight terminal in question consists of two buildings, one for outbound and one for inbound freight, each about 1,000 feet long. Between these parallel buildings are the seven house tracks, interspaced with two transfer platforms, thus dividing the tracks into three groups. The house tracks come to a stub end on a line with the inner end of the freight houses, and a cross platform connects the two longitudinal platforms and the two freight houses at this point. Now it is obvious that to transfer goods from a point on one transfer platform to a point on another transfer platform, or from one freight house to a platform or to the other freight house, the electric tractors and trailers employed in the work would have to make a round-about trip, going down the platform to the cross platform and then up the other platform or freight house to the desired point. Depending on how far up the platforms the points of departure and arrival happened to be, a trip of several hundred feet or even a thousand or more feet would be quite common.

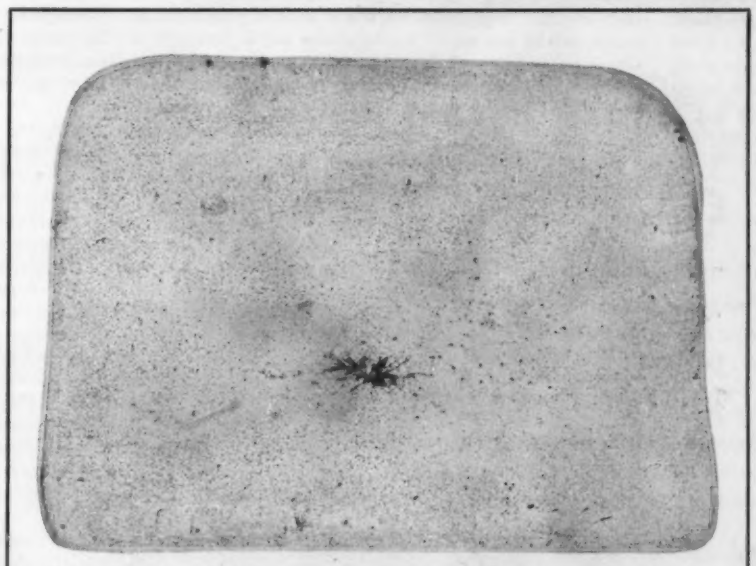
It was to eliminate these long trips that the railway engineers introduced a system of lift bridges for spanning the intervening tracks so that goods might be transferred from one platform to another by a more direct route. At first the bridges were of an elementary design and had to be removed by hand each time a train of cars was moved. A string of cars standing alongside a platform was divided opposite each bridge to make room for it.

But the bridges, while most practical as a means of saving trucking expenses, proved rather expensive because of their manual operation, and a study of power-operated bridges disclosed the fact that these would effect a considerable saving over the existing ones. As a result, two bridges have been installed of the type shown in the accompanying illustration, providing movable spans over the three groups of tracks at two intermediate points in the length of the station; while in the throat of the yard a third bridge has been installed.

It will be noted that the bridges consist of platforms which, being hinged at their lower end, can be raised or lowered by means of cables winding up on drums driven by 7½ horse-power alternating current motors. One motor operates the three-track bridge, while another motor operates the two smaller bridges simultaneously. Controllers are installed on the posts of the operating structure, and the motors are provided with automatic cut-offs which shut off the current supply when the bridges are fully opened. Since these bridges come up to a true vertical position when opened, the weight of the bridge is in no way effective to start it downward when the bridge is to be closed. It is particularly when a wind is blowing against the bridge in a direction opposite to that of the closing movement that this feature becomes quite an obstacle in the operation. Fortunately, however, pushers are provided which push the bridges out to a sufficient distance to make the weight of the bridge effective in carrying it downward, and which also serve as buffers when the bridges are opened. For the two smaller bridges the pushers are operated by counter-weights, while the larger bridge employs a motor operated pusher.

The operation of the bridge is simple. When the bridge is to be closed a drum in clutch with the motor operating the bridge through worm drive, winds up a cable and the pusher is forced outward. When the full reach of the pusher has been obtained a small lug on the end of the pusher rod comes in contact with the clutch lever and throws the drum out of clutch with the motor, so that the pusher remains stationary during the remainder of the downward movement of the bridge. A reversal of this operation takes place in raising the bridge.

These two electrically operated lift bridges reduce the trucking distance in transferring freight from platform to platform



The little patch of sulfur showing dark in the center makes this steel bar unfit for many purposes

The Geophysical Laboratory at Washington. Left—gage to measure high pressures. Right—press which develops pressure of 4000 atmospheres at 1000° Centigrade

Segregation in Steel

By Duncan Taylor

MUCH is being said and written upon the subject of steel segregation. Briefly, this means a separation out of the sulfur content, present to a certain percentage in all steel, so that instead of being mixed uniformly throughout the mass of the material, the sulfur is found more or less aggregated in one part only. The practical steel man is gradually becoming impressed with the importance of segregation; and a recent experience in the effects of this phenomenon upon seamless steel tubing will indicate the necessity of preventing it, and throw a little light upon the sort of problem which the steel maker has to face.

Seamless tubing is made by forcing a steel billet over a piercing tool while at high temperature. It is then pressed over sizing mandrels and rolls, and otherwise treated like ordinary welded pipe. There is a strong twisting action on the billet while forcing it over the piercing tool, and many pieces have to be scrapped because of slippage of one layer of the metal on another under this strain. Once such slip occurs, it cannot be welded together by further rolling, and must go into the discard.

My company recently found itself in danger of losing a valued customer, because its steel was not up to the requirements of the seamless tubing made by the latter. A large percentage of the billets pierced had buckled, showing a partial slippage of the metal. A competing steel of the same analysis and under identical conditions gave very little trouble.

Exhaustive chemical and heat tests applied to stock steel and to pieces which had failed as described did not show any decisive difference between our steel and that of the competitor. As a final test we took sulfur prints of the ends of the pieces of defective pipe, though none of us had any idea that segregation really lay at the root of the matter. Without going into details, I may say that this process consists of photographing the end of the pipe on such a paper, and developing in such a solution, that in the finished print all the sulfur in the section of the steel exposed shows as dark brown spots.

In this test we obtained two very interesting prints which made it clear why our steel was not suitable to the conditions of this tubing. The piece of defective pipe exposed was four inches in outside diameter,

(Concluded on page 161)

Rocks and Minerals Made by Artificial Means

By L. William Thavis

THROUGH the steady progress of science, nature's secrets are being bared one by one, and not only is her most sacredly guarded secret—how earth was made, of what its rocks and minerals are composed—now being solved, but actual rocks and minerals are being reproduced by artificial means, reproduced in a much purer form than they were originally made by nature. The place at which these wonderful experiments are being conducted is the Carnegie Geophysical Laboratory, a part of the Carnegie Institute of Washington, D. C.

Nature has not given up her secrets willingly. They have been wrenched from her by hard work and the expenditure of large sums of money. The Geophysical Laboratory represents an outlay of half a million dollars, and what will be spent in the future for conducting these experiments is not known. While the brain of man of course is the dominating factor in this work that brain is helped out by intricate and costly machinery. There is a furnace where a heat of 3,000 degrees Fahrenheit may be obtained; there is a machine capable of exerting a pressure of 100,000 pounds to a square inch; there are measuring and recording devices of the most exquisite delicacy.

The Carnegie Geophysical Laboratory is a building within a building. Outside the exterior brick wall is an insulating layer composed of six inches of hollow terra cotta, with air spaces laid horizontally and closed at the ends. This insulation, which will keep the heat out in summer and in in winter, is almost as strong, structurally, as the brick wall underneath. The delicate measuring and observing instruments in the laboratories on the upper floors are protected by a novel arrangement from the jar of the heavy machinery below. Each basement room containing heavy equipment has for floor a thick slab of cement separated from the adjoining walls, bottom and sides, by a six-inch layer of dry sand. These same delicate instruments are protected from dust by filtered air.

"Rock formation, like other physical and chemical phenomena," says Dr. Arthur L. Day, director of the Geophysical Laboratory, "is the result of certain forces acting upon certain forms of matter. An exact knowl-

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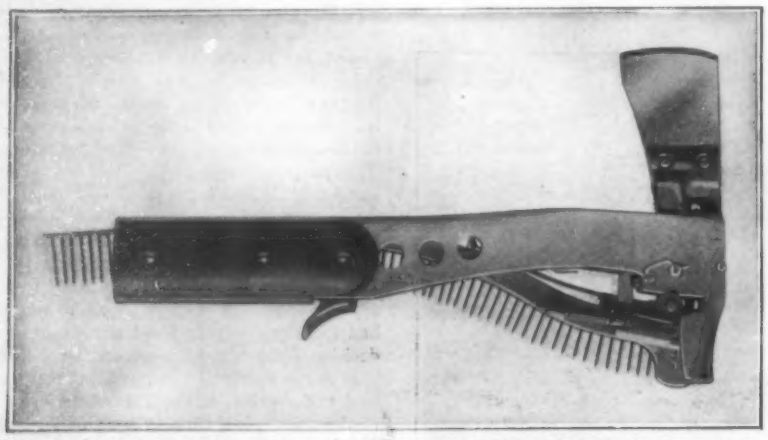
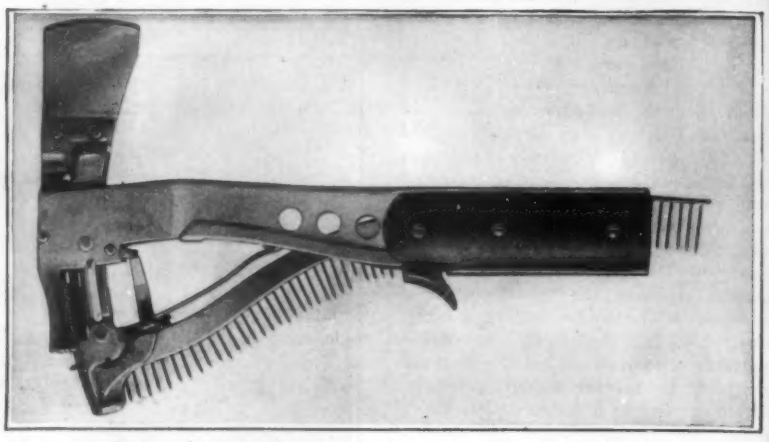
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



After delivering the nail, as many blows as necessary may be struck



The machine-gun hammer loaded and ready for the first blow

A Machine-Gun Hammer Hatchet

IT has been truthfully said that without tools the human race would yet be living in caves and following savagery. Particularly do Americans owe their commanding position in the industrial world to novel and labor-saving tools. Our best brains are busy daily striving to invent new implements which will lessen man's work and materially increase his efficiency.

A tool recently invented in California, promises to revolutionize certain trades, and be an all-round benefit to humanity. The new invention might be popularly termed a machine-gun hammer-hatchet. It will drive nails and tacks much as a machine gun peppers bullets into a target, except that it will be a certain marksman. The automatic hammer is designed for lathing, and will be a distinct benefit to men following this trade. No longer will the dangerous custom of making the mouth a "pouch" for lathing nails have to be followed, and a lather can lath as well in zero weather as in summer. The nails are fed into the hammer on a paper band, much as bullets are fed in clips into machine guns. Thus, the tool can be as well manipulated with gloved hands as with bare fingers.

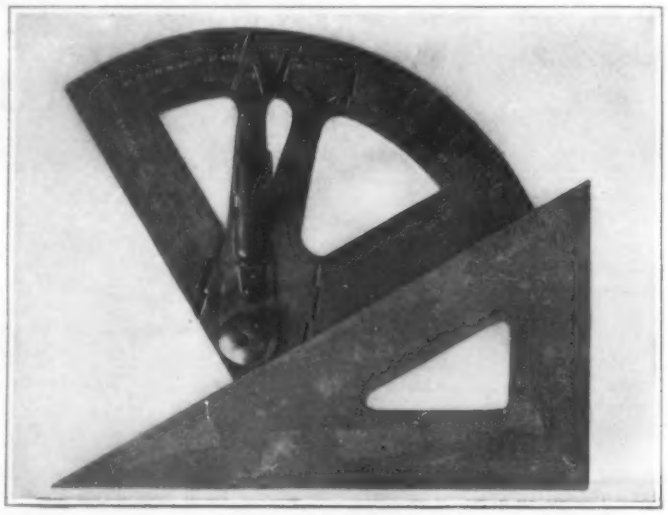
Furthermore, a lather can nail 1,000 more lath per day with the hammer, and do it better and more easily. The tool drives any kind of nail from a tack up to a four-penny nail. It also effects a saving of nails, and is guaranteed never to bend a nail or break it. The hammer may be taken entirely apart in five minutes, and a strip of nails can be taken from it readily. Only one hand is requiring for driving, leaving the other free for other work. The hammer works from a thumb trigger, and more than one blow may be struck, if desired, before another nail is fed into position for driving. As in the case of shoe-making machinery in use in the eastern factories, this automatic hammer will be leased, and not sold, when ready for marketing. The inventor plans to make and sell the nails and tacks especially for use in his hammers.

The tack hammer is of a different type from the lathing hammer. It likewise drives at one stroke, with a trigger action for two strokes, or for pounding when desired. Actual tests show an average speed increase in driving tacks of 50 per cent in houselining, bill-posting, upholstering, decorating, etc. Any one who has ever had a seance at tacking down a carpet or a matting will at once realize what a blessing a hammer carrying, setting and driving its own tacks really is.

The inventor also holds patents on a shoemakers' lasting pincer, of the same general type as the hammer. These pincers are the first and only successful combination of the kind, and they increase the speed of lasting in the same ratio as the hammers do in other trades.

A Spirit-Level Protractor

FROM time to time some ingenious mechanic or draughtsman bobs up with a combination of several simple and well-known devices or principles to produce a new effect of interest and value. Such a device is the combination of the spirit-level and the protractor which we illustrate, and which was worked out by a Rochester man, who in the course of his employment has frequent occasion to measure the pitch of a roof while working on top of the roof. It is easy enough to measure an angle with a protractor if access can be had to the inside of the angle, but where this is not the case the exact solution of the problem introduces a difficulty that is ordinarily hard to overcome.



Measuring an internal angle from outside by aid of the spirit-level

The ingenious inventor has disposed of this by building a spirit-level into the movable arm of his protractor. Placing the business edge of the protractor along the roof, he is able to set this arm in an exactly horizontal position with extreme ease. He then takes advantage of the fact that alternate interior angles made by a transversal cutting two parallels are equal to read from the scale the pitch of his roof referred to the horizontal surface of the ground. On the inner arc of the protractor is a scale in degrees on the outer arc, a scale that readily shows the number of inches of pitch per foot.

Thus either or both ways of measurement may be employed. It will be noted that the instrument is furnished with a pair of hinges for folding into a very small compass and thus easy to carry in the pocket or in any other restricted space.

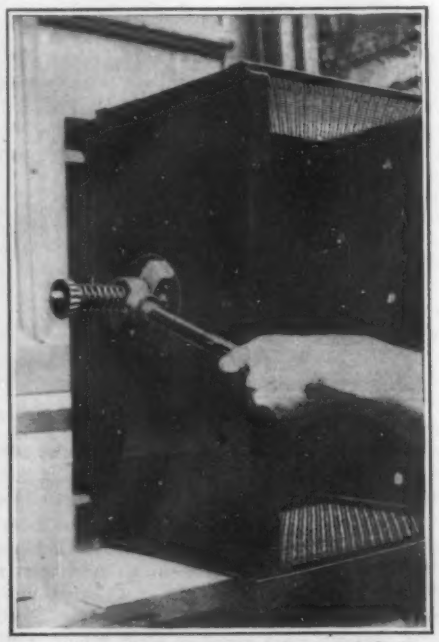
Statistics of Forest Fires

THE Forest Service has recently undertaken to secure annual statistics and estimates concerning forest fires in the United States, and has published such data for the year 1915. In some States the reports collected relate to the whole forested area of the State, but in others reports were not available for all forests and have therefore been supplemented by estimates. On this basis it is announced that there were about 40,000 fires during the year, which burned over about 6,000,000 acres, or 1.1 per cent of the total forest area of the country. The money loss in timber and improvements was not less than $7,000,000, which does not include the loss in young tree growth on large areas outside the national forests, nor the great damage from soil deterioration and floods. Seventy-four per cent of the fires were of known origin, and of these lightning accounted for about one-seventh. Most fires occurred from preventable causes.

A New Handy Quick-Operating Cutter

THE usual way of making an additional hole in a cabinet to accommodate a piece of conduit, or drilling an opening of desired size in metal lockers or enclosing cases, has been the source of considerable trouble. A new and easily operated tool has now been invented for this work. This device can be used for cutting all sorts of metal, fiber and slate, and can be adjusted to cut holes of various sizes with little effort and in but a few moments. To use the tool, all that is necessary is to drill a pilot hole through the material and through this pass the stud. A flange-nut is then secured on the opposite side of this stud and a few operations of a ratchet wrench cuts out a neat hole. A test conducted recently showed that for a standard conduit cut-out box (wall about 1 inch), 14 revolutions of the knives sufficed to cut a hole and the time required was less than a minute. The illustrations herewith show one of the uses of this appliance. The knives, which may be adjusted for cutting holes of several diameters, are held in a swing chuck and are automatically fed by means of the spring shown between the swing chuck and the thumb-nut. This device does the work of a 6-inch drill press and it is particularly desirable because it can be taken to the work, rather than having the work brought to it. In the case of a tank where the flange-nut cannot be secured to the stud on the inside it is only necessary to tap the pilot hole and insert the stud into this hole. While but a few of the uses are mentioned above, the inventor claims that this tool is useful in automobile garage, or boat building plants and, in fact, in all industrial works.

Side view, showing flange-nut in position



A quick and handy way to enlarge a hole in a metal sheet

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Rocks and Minerals Made by Artificial Means

(*Concluded from page 157*)

edge of rock formation accordingly will depend upon the ability to establish definitely the characteristic properties of these particular forms of matter and to measure the forces which act in each case. The facts that in nature the individual rock-forming minerals do not occur in great purity, and that the active forces are applied over a great range of conditions and long periods of time, merely encumber the problem with technical difficulties of considerable magnitude; they do not confuse its analysis."

The efforts the Geophysical Laboratory has so far made may be grouped as follows:

First. To extend the methods of accurate temperature measurement to include the entire field of rock formation. This work, covering the establishment of a fundamental temperature scale and several models of applying it to the minerals, is now completed for a temperature range up to 1,550 deg. Centigrade (2,822 deg. Fahrenheit), where all known rocks are molten.

Second. After devising means to determine the temperature at which minerals form, thus providing a temperature scale in terms of which the history of the cooling earth could be expressed, it became necessary to measure the amount of energy involved in certain phases of the formation process. Here, again, the methods of physics were complicated in technical character and seriously limited in scope and accuracy. Hardly an attempt had been made to determine the quantity of heat involved in chemical reactions at temperatures as high as those at which minerals form, and even in the most successful temperature region—that is, at the temperature of everyday life—an error of 0.5 per cent was usually considered inevitable in such measurements. Of the results attained at the Laboratory, it may be said that specific heats can now be measured in any portion of the temperature range stated above with an accuracy ten times greater than that found in similar measurements at ordinary temperature.

Third. The microscopic examination, or more generally the determination of the crystallographic and optical character, of the crystals formed in the solutions. Early in the investigations of the Laboratory it appeared that the attempt to produce in the laboratory crystal types of high chemical purity almost invariably resulted in crystals so small, when compared with those found in nature, that the usual methods of study were not equal to the task unless considerable sacrifice of accuracy were made. From their quantitative viewpoint, obviously, sacrifices of this kind were carrying the experts in the wrong direction. The question of methods and technique in the determination of crystals under the microscope was therefore taken up with similar thoroughness and is now practically completed. Submicroscopic crystals, of course, are no more accessible to study than heretofore, but crystals of but a few hundredths of a millimeter in their chief dimensions can now be determined with as great certainty as is ordinarily possible in large natural crystals.

Our Largest Foreign Order for Cast-Iron Pipe

ONE of the largest contracts for cast-iron pipe ever made has been placed by the Argentine Republic with the leading maker of such pipe in the United States, and it is the first one that country ever placed here. It calls for 60,000 tons of pipe, valued at $3,500,000. It involves approximately 2,500 miles of pipe or what is ordinarily enough to completely equip a city of a million people. It will require at least 4,500 standard freight cars to move the pipe from the foundries to the shipping port and approximately 20 vessels to carry it to the Argentine Republic. The technical commission, appointed by the Republic to supervise the manufacture of this large contract, recently arrived in this country. The American company's bid was $60,000 lower than that of the British founders.

Forty Thousand Miles on a Fifth Avenue Bus

IN the eleven months ending October 31, 1916, the Fifth Avenue Coach Company, New York, had placed in service 259 Goodyear S-V Pressed-On Truck Tires.

On this date Mr. G. A. Green, Chief Engineer of the Company, looked up the records of these tires and sent to Goodyear the most remarkable tabulation of truck tire performance the world has ever seen.

Of the 259 tires, eleven had been retired from duty. In Mr. Green's words these tires had "failed." But before "failing" they had delivered an average mileage of more than 17,000—the lowest nearly 10,000 and the highest more than 28,000.

Two hundred and forty-eight were still running.

Three of them had gone between 35,000 and 40,000 miles. Two months later, on December 31, one of these three had gone 49,324 miles. And still going.

Thirteen had covered between 30,000 and 35,000 miles. And still going.

Fourteen had gone between 25,000 and 30,000 miles. And still going.

The rest were younger tires. They had not yet had time to go so far. But all of them were on their way to a place in the greatest record ever made by tires—of whatever kind or type.

Those who have ridden on Fifth Avenue busses—or have seen these great coaches skimming along with their burdens of living freight—know that these tires have had no easy job.

Practically every mile is a loaded mile. The speed is greater than the average truck—particularly in the upper reaches of Manhattan, where the traffic is not dense. Brakes are used much more frequently than in commercial trucking. And the loads are great.

But the work of S-V for the coach company, though spectacular because of the number of tires employed, is merely an index to what this wonderful tire is doing, in varied service, all over America.

If *your* trucks are not equipped with S-V's probably you are not getting all that you ought to get, in efficient tire service—at a low cost.

The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR
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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

HAT PRESS.—F. HERR, 628 6th Ave., Astoria, New York, N. Y. The invention provides means for shaping hats constructed from braid or similar material and for drying the same coincident with said shaping; provides a dry medium for pressing the hat form to a commercial shape and therefore avoid the uncertainty of shape in the final product, to which the present method is subject; and provides efficient mechanism to attain the objects stated.

GARMENT HANGER AND STRETCHER.—C. J. DAHLGREN, 212 Broadway, New York, N. Y. The purpose here is to provide a hanger and stretcher which is very simple in construction, more especially designed for supporting trousers and similar garments, and arranged to engage the lower ends of both legs of the garment and hold the same stretched to properly maintain the creases.

Electrical Devices

TELEPHONE ATTACHMENT.—J. O. MORRISON, 11 Horlbeck St., Charleston, S. C. This invention provides a signal device which is of comparatively simple and inexpensive construction, compact and light of weight and so designed that it can be readily used as an attachment for wall or desk telephones to which the attachment can be fastened expeditiously and without any skill being required.

SIGN.—J. F. KAISER, 422 Dewey Ave., Bartlesville, Okla. One of the objects here is to provide a sign for show window display, in which removable display cards, made of ordinary paper, are used in an illuminated sign which will flash from one color to another at regulated intervals, and so attract the attention of prospective customers.

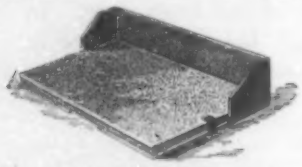
Of Interest to Farmers

FRUIT SEEDER.—D. PHILLIPS, Daytona, Fla. The invention is a separator and is designed chiefly for removing seeds, stems and like solid particles from the pulp of fruit and comprises a rotary member for receiving the pulp to be separated, a second receptacle for catching the product as the same escapes from the separator, and a pocket or like part for receiving the seed and other matter separated from the pulp.

PLANT BLOCKING OR SPACING MACHINE.—H. M. SIEMANN, Fort Lupton, Colo. The inventor provides a machine having a plurality of radially arranged arms associated with a wheel and provided with cutting or chopping means and adapted as the wheel rolls along the row of plants to be successively operated for cutting or chopping the plants at spaced intervals, whereby to properly block the row.

Of General Interest

POST CARD TRAY.—P. H. KRAETSCH, 534 Franklin Ave., Astoria, Ore. One of the principal objects of this invention is to provide an improved tray for receiving post cards and unmounted photographs and the like, the tray being so constructed as to retain the cards or photographed in flat extended position, and to allow inspection of them without requiring their removal from the tray.

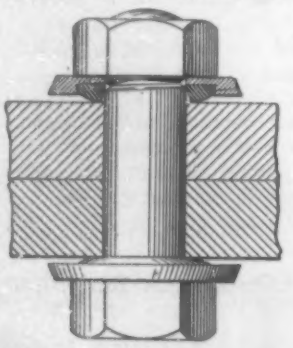


POST CARD TRAY

MEANS FOR PROTECTING CORNS.—P. WETZEL, 29 Clove Road, New Rochelle, N. Y. The invention provides means for protecting corns consisting of elongated protectors which are disposed at the rear of the corn, and longitudinally of the toe having the corn, an end of the protector being concave. Thus an extensive surface is disposed adjacent the corn, to prevent undue pressure of the shoe thereagainst, while the protector is so disposed that it is prevented from pressing against and irritating the corn under normal conditions.

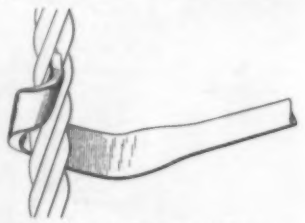
Hardware and Tools

WASHER.—M. MOSER, Juneau, Alaska. The invention provides a washer with a resilient ring gasket carried thereby and so formed and arranged on the face of the gasket as to extend to the opening in the washer, whereby to cause the tightening up of the nut on the bolt to compress the gasket against the opposed surface of the article being clamped and thereby constrict the gasket on the bolt to prevent the rattling of the latter, and to cushion the same against shocks, as well as to assist in giving a better binding action of the washer against the nut.



WASHER

CABLE TWISTING DEVICE.—P. A. WELSBY, Box 581, Sapulpa, Okla. The invention provides a simple tool to be used primarily in twisting the cable used in connection with well drilling, such as oil wells and the like, which will not injure the cable. It provides a tool made in one piece and therefore not liable to get out of order, as are more complex devices. When applied to the cable the tool will grip the cable tightly, and will not work itself up and down the cable.



CABLE TWISTING DEVICE

Heating and Lighting

CAMP STOVE.—A. H. GREEN, care of Wm. J. Links, 634 E. 24th St., Los Angeles, Cal. The invention has reference to stoves and particularly to an improved arrangement of folding stove, and has for an object the provision of an improved construction especially adapted for camping outfits, the parts being so arranged as to require a minimum space.

AUTOMATIC GAS CUT-OFF.—J. W. SMITH, 502 Greene Ave., Brooklyn, N. Y. Among the objects of the invention is to provide a novel type of compound valve including a plurality of independently movable parts with facilities coöperating therewith to cause the shutting off of the flow of gas or other fluid automatically in the case of local fire.

Household Utilities

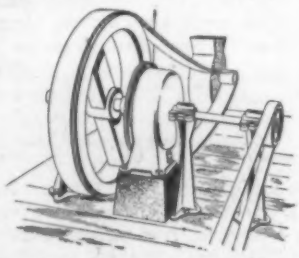
CLOSET TANK BALL COCK.—E. R. HILL, New Albany, Miss. The invention has particular reference to ball cocks for flush tanks. Among its objects is to provide a new and specific form of valve mechanism including a flexible diaphragm located between relatively fixed and movable valve parts, said movable part being controlled by lever mechanism from the float.

Machines and Mechanical Devices

CONTROLLING AND ALARM DEVICE.—L. M. PLANSOEN, care of M. Constant, Union Bank Bldg., Garfield, N. J. The invention relates to paper-making machines of the Fourdrinier type, and provides a device located at the delivery end of the endless wire screen and arranged to shift the delivery end of the screen back to normal position in case of a deflection and at the same time sound an alarm for the attendant to manipulate the usual hand guide roll at the other end of the machine.

GROCER'S CABINET.—J. F. ALLEY, 1028 Shelby St., Bristol, Tenn. The improvement provides a cabinet having a plurality of separate compartments and chutes for the various commodities, each chute having a novel arrangement of valve mechanism operable by the pressing of a key, and adapted to be electrically released when the scale of the apparatus weighs the amount of commodity desired.

MECHANICAL POWER TRANSMITTING DEVICE.—F. J. WILLIS, R. F. D. No. 8, Troy, Ala. This inventor provides a device to which power may be applied at a certain speed and converted into power of greater magnitude at a slower speed. He provides a device which may be used under circumstances where the available machinery is of too great a speed to be utilized for such purposes as operating rock and coal crushers, and in such instances the available power at excessive speed can be changed to greater power at a suitably low speed for the operation of such devices as named by the applying of his invention.



MECHANICAL POWER TRANSMITTING DEVICE

DYNAMOMETER.—W. R. KLECKNER, Via Bay Point, Cowell, Cal. This invention is particularly adapted for measuring graphically the tension of flexible power-transmitting members, such as chains and belts. It provides a device which can be easily and quickly applied to a drive for measuring the tension in the flexible power-transmitting member.

GLASS BEVELING MACHINE.—W. J. POROWSKI, 199 Wooster St., New York, N. Y. This improvement refers to a glass-beveling machine, particularly adapted for the beveling of disks. It provides a machine which is automatic in its action and in which the disks to be beveled are maintained in position while beveled by pneumatic means.

PROPELLER LIFTER.—W. H. MICHEL, 9 Portland Ave., Clifton, N. J. This invention relates particularly to means for actuating the propeller and also for raising the same when the boat passes over an obstruction. It provides a shifting mechanism for the driving mechanism of the propeller whereby the driving mechanism is caused to automatically raise the propeller to a position above the bottom of the boat.

TYPEWRITER.—S. A. THOMPSON, 644 1st Ave., New York, N. Y. Mr. Thompson's invention pertains to typewriting machines in which the carriage is provided with a rotary type form having printing types arranged in an angular series near the edge, the carriage being adapted to be depressed for printing after locating the type at the printing point.

IGNITION SYSTEM.—L. A. SNYDER, Address Jones & Snyder, care of Jones Hardware Co., Box B, Haileyville, Okla. The inventor provides a mechanism adapted for use in gas, gasoline, kerosene or other liquid fuel heating or lighting apparatus, wherein a sparking mechanism is arranged in position to ignite the fuel, the said mechanism being combined with a high tension spark coil, a combined selector switch and timer and a suitable generating apparatus.

POWER TRANSMISSION DEVICE.—L. R. CARROLL, 14 S. Brevard St., Charlotte, N. C. The invention relates more particularly to a leverage system of transmitting rotary power from one point to another, and increasing the power in its transmission between such points, the object being to provide a readily operated means, capable of convenient erection and extension from point to point.

PROJECTILE.—W. S. CRANE, Randolph, Vt. The projectile is provided with a body having arms pivoted thereto for extending outwardly when freed, to engage and destroy wireless stations, entanglements and air craft, novel means being used to hold the arms close to the body, and for freeing and extending the arms relatively thereto.

WIND MOTOR.—E. C. RODWICK, Ukiah, Cal. The invention relates to a wind mill arranged to operate any suitable apparatus, but is more particularly intended for driving an electric generator. It resides principally in the form and arrangement of the wind blades, means for throwing the same into and out of the wind, and drive gearing.

Musical Devices

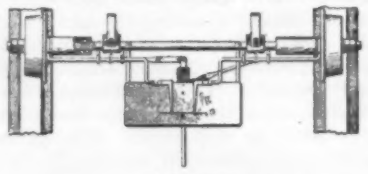
WOOD WIND MUSICAL INSTRUMENT.—G. STERNBERG, Agana, Island of Guam. This inventor provides a keyboard for use in wood wind musical instruments, as for instance flutes, clarinets and the like, so constructed and arranged as to permit the player to make all the notes without shifting his finger or changing the position thereof, and without the necessity of cross fingering.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—A. H. FORSYTHE, 319 E. 3d St., Joplin, Mo. The invention provides an engine in which the cylinders have but one port, each, adapted for communication with the intake and exhaust passages of a rotary valve alternately, in which the valve is vertically arranged and of conical formation; in which the heated exhaust gases are practically surrounded by cool air or mixture on their outward passage through the valve; in which a layer of dead air is interposed between the intake and exhaust gases in the valve; in which means are provided for compressing air for storage in a tank; and which may be started by means of such compressed air.

Railways and Their Accessories

TRACK GAGE.—L. W. KRAKE, Route 1, Box 111, Bonduel, Wis. This invention is designed for the purpose of inspecting tracks to determine the location of any spreading thereof and to this end there is provided a pair of track engaging elements movable relative to each other and adapted to be adjusted upon a track and actuated by variations in the width of the latter to operate an indicating device which determines the amount of such variation.



TRACK GAGE

Pertaining to Recreation

GOLF CLUB.—P. H. LYNCH, 520 W. 142d St., New York, N. Y. In this golf stick the shaft is of novel design, conducive to the perfect balance of the shaft in the hands of the golfer and to the proper whip action, these results being obtained by the shaft adjacent the handle, a longitudinal split, the plane of which is parallel with the sticking face of the head, and in this split is set a filling of rubber or other resilient material and in the butt of the shaft is a weight which insures the proper balance.

Pertaining to Vehicles

WHEEL RIM.—L. G. FLEMING, Tarrytown, N. Y. This inventor provides improvements in wheel rims whereby provision is made for quick and convenient removal or replacement of the tire. To accomplish this use is made of a rim consisting of a ring having an integral inner flange and another flange, of which, a portion is integral with the ring and the other portion is detachably connected with the felly of the wheel.

MUD GUARD.—W. J. SHERRINGTON. Address Day, Davies & Hunt, 321 High Holborn, London, W. C., England. This improved device comprises a sectoral apron mounted on a sectoral carrier depending radially between two rings and supported by antifriction bearings resting in races in the rings on both sides, the rings being connected at their smallest peripheries and adapted to form a rigid structure with the wheel rim.

FIRE PUMP. H. F. MOLKENDUR, 337 Forest St., St. Paul, Minn. This improvement pertains to pneumatic tires such as are used on automobiles, and the main object thereof is to provide automatic means interposed between the inner tube and its casing for maintaining the air pressure within said tube, said means depending upon the resiliency of rubber for operation.

SHOCK ABSORBER.—W. F. MCNARR, care of Vanadicim Bldg., Pittsburgh, Pa. This invention has for its general objects to improve and to simplify the construction and operation of shock absorbers so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture and to keep in operative condition, and so designed that it will automatically maintain its resiliency.

VEHICLE WHEEL.—T. A. RYAN, 162 Woodworth Ave., Yonkers, N. Y. The invention provides a wheel having a well protected cushioning tube to render the tire puncture-proof, at the same time providing the desired cushioning effect to insure easy riding of the occupants, the load being equally well distributed around the tube so that the pressure is practically equal at the top, bottom and sides.

NON-SKID CHAIN.—J. KIRKWOOD, Lenox, Mass. This invention has for its object to improve the construction and operation of non-skid chains for rubber-tired wheels in such a manner as to make them more effective as to their gripping property, more durable and satisfactory in action, and otherwise to simplify and cheapen as well as to generally improve this type of devices.

BRAKE FOR AUTOMOBILES.—A. J. SPEARE, Westplaines, Mo. The inventor provides ground engaging elements normally retained in raised position and quickly released to engage the ground and thereby raise certain of the wheels of a vehicle and render the same inoperative whereby the machine may, in an emergency, be quickly brought to a complete stop.

ATTACHMENT FOR STEERING DEVICES FOR VEHICLES.—W. H. HOUSMAN, Chatham, N. Y. This improvement provides a resilient attachment for steering gears applicable especially to automobiles and serving to hold or tend to hold the steering gears in mid or neutral position with the further or additional advantage of rendering the hand operation of the vehicles easier and more agreeable to the driver.

ROBE FOR AUTOMOBILES.—H. A. Z. ADLER, Box 466, Portchester, N. Y. This invention relates to robes for automobiles such as shown and described in Mr. Adler's Patent No. 1,164,445, December 14th, 1915. The purpose of the present invention is to provide a robe arranged to permit convenient attachment to automobiles and similar vehicles of different makes and different width of body and that of the windshield.

BICYCLE DRIVING AND BRAKE MECHANISM.—G. B. SWAINSON, 418 N. 40th St., Philadelphia, Pa. This improvement provides quick acting means for transference of the mechanism from a driving to a braking condition; provides a brake ring of the expansion type adapted to present a maximum friction surface; improves the mechanism employed for expanding the brake ring; and obtains increased efficiency by means of the mechanism embodying the invention.

SIGNAL CHIME FOR AUTOMOBILES.—C. P. JONES and IDA M. JONES. Address the former 3724 E. 71st St., Cleveland, Ohio. The general objects of this invention are to improve and to simplify the construction and operation of signal devices so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed as to give a musical tone.

HEADLIGHT SHUTTER.—W. L. LARGE, Towaco, N. J. This improvement provides a headlight or attachment for existing lamps in which these are provided a plurality of shutter elements so arranged and manipulated as to obstruct more or less of the light according to requirements, the means to manipulate the same being controlled by electric means within reach of the driver or other person.

AIR CUSHION FOR AUTOMOBILES.—R. KRAUSE, Belhaven, N. C. This invention has particular reference to cushioning devices for the chassis designed to replace the usual springs and shock absorbers. It provides supports rigidly secured to the chassis and connected to a plurality of cushioning devices, certain parts of which are fixed and others movable relative to the axles.

AUTOMOBILE LAMP.—C. W. CANFIELD, Brownton, Minn. The particular purpose here is to provide a lamp with means under the control of the operator whereby the lamp may be instantly shifted into different positions and yet when released from any of said positions will automatically return to a predetermined normal position.

MOTOR CYCLE STAND.—A. W. MOULTON, Derby Line, Vt. In this patent the inventor has reference to motor cycles, or more particularly to the stands therefor, and the main purpose is the provision of a stand which overcomes the present necessity for manually lifting the rear of a motor cycle in order to bring the stand into operative position.

Designs

DESIGN FOR A KITE.—W. A. COLLINS, 872 Driggs Ave., Brooklyn, N. Y. In this ornamental design for a kite the face view shows the article in two sections both of triangular form and nearly identical in shape, the upper one being much superior in area than the lower.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

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Aviator's Compass That is Visible at Night by Its Own Light

(Concluded from page 156)

ing glass, mounted in the bezel ring and fitted over the dial, enlarges the figures on the latter so that they may be read more easily. A nickel ring attached to the outside of the bowl is for convenience in carrying the instrument with a strap, if desired.

To increase the accuracy of this compass, the card is mounted in a mixture of alcohol and distilled water, thus rendering the magnetic float more bouyant and sensitive. The markings on this compass are readable at night in the light from the radium dial, which is graduated every five degrees and numbered every 20 degrees. The east zero is omitted in all numbers to avoid crowding.

Segregation in Steel

(Concluded from page 157)

three and a half inside. This quarter-inch metallic ring showed up in the picture very brown near the inside surface and clear white on the outside, with a well defined dividing line about through the annular center.

In comparison with this, the picture of the end of one of our four-inch billets, from which such pipe was drawn, showed clear about the circumference, but spotted with brown through the central regions. In other words, segregation was very marked, and in a most unfortunate manner. For the piercing tool removes no metal, it merely forces all the center metal of the billet to the inner surface of the tube, pressing it into streaks circumferentially.

The results of this were disastrous. It is well known that sulfur melts at a much lower temperature than does steel. Consequently at rolling temperatures we have next the piercing tool a layer of plastic or even fluid material; and under severe twisting strains the steel cannot help but fail along these greased planes, as they may well be called.

It is quite astonishing how much harm a little sulfur can do, when misplaced in steel.

Facts About the Panama Canal

(Continued from page 147)

figure is less than the forty-eight ships per day expected of the Canal, but that figure could be attained by shutting down the hydroelectric station and using the auxiliary steam generating station. The year of minimum discharge of rivers into Gatun Lake of the twenty-five on record gave an average value of 4,435 sec. ft. If all this water was utilized by proper storage by the building of the Alhajeula and additional dams the average water capacity of the canal for the year would be about 2,600 sec. ft., sufficient for the passage of about forty-eight ships a day and for sixty ships a day with the hydro station shut down.

The maximum momentary discharge into Gatun Lake from its tributaries on record is 175,000 sec. ft. and on one occasion a flow of 137,500 sec. feet occurred for a period of thirty-three hours.

Gatun Spillway, built for disposing of the surplus inflow, has a discharge capacity of approximately 180,000 sec. ft. with the lake at elevation 87 ft. The maximum number of gates opened to date has been

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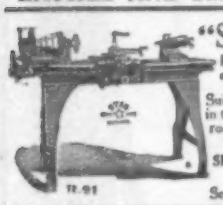

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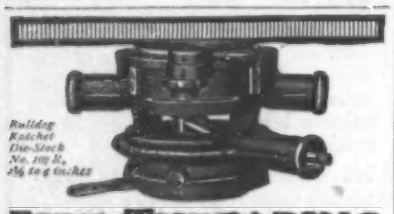

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eight, giving a discharge of a little over 100,000 sec. ft. By way of comparison, the total discharge of Niagara is estimated at 250,000 sec. ft., or 15,000,000 cu. ft. per minute. Water is drawn into the locks at a maximum rate of 923,600 cu. ft. per minute, and the average flow while filling the chamber is 492,000 cu. ft. per minute.

Some engineers thought that a maximum rate of 1.5 feet per minute to lift vessels in the locks was the safe limit. Gen. Hodges, who was in charge of the design of the locks, decided to figure on double this rate, or 3 feet per minute; and to accelerate the last part of the flow before the levels equalize, he had incorporated in the design a center wall culvert which could be used for either of the twin locks. Actual experience has shown that, with the towing locomotives holding the vessels central in the locks, the maximum rate, given by both culverts fully opened, of 7.5 feet per minute is perfectly safe, and in consequence instead of making the total lift in 15 minutes, as originally contemplated, the lift is actually made in eight minutes, which means a saving of approximately twenty minutes at Gatun Locks in locking.

The time would, however, be ten minutes for the lift instead of eight, if it were not for the fact that the water overtravels its levels and the slow rate of filling or emptying the lock chambers, as the head decreases to a small amount, occurs after actual equalization and the gates are consequently opened before flow ceases through the lock culverts. The flow of water does not follow the old accepted formulæ and the development of the corrected formulæ shows that, in the future, locks may be designed to make larger savings in time and to make more uniform the rate of handling the vessel through the entire lift.

The rapid handling of water, this characteristic of its flow, combined with the propulsion of the ships by the towing locomotives and the operating of the lock machinery by remote central control, all have combined to make the locks surpass expectations of their capacity.

The remote control and towing locomotives are also a safety feature. The locomotives have fixed speeds, being driven by induction motors, and tow vessels through the locks at the rate of one or two miles an hour as desired. The remote control operation makes possible interlocking of machinery to avoid wrong sequence of operation and eliminates the possibility of mistaking of instructions, which would occur sooner or later if the machines were operated individually by operators at various stations on the locks. Under the present system a pilot on the ship directs its movements in the locks, a foreman on the wall follows each vessel and reports its progress by telephone to the operator in the control house. The operator can also see where the vessel is located and he checks the foreman's reports and operates all the lock machinery controlling the flow of water and lock gates. The operating board gives the exact position of all valves, gates, water levels, etc., and the movement of the main machines is duplicated by its indicators.

The main gates in the upper levels of all locks are duplicated and one gate is used as a guard or safety gate for the other. Guard chains are also provided for gates in the upper level and for the lower entrance gates. A test was made on one of these chains by running the Steamship "Cristobal" into it when fully loaded and displacing about 16,000 tons and at a speed of 2.5 miles per hour. The chain stopped the vessel in approximately fifty feet of travel after striking and without any damage to the vessel or chain. If the unexpected should happen and the gates, destroyed in one of the upper levels the discharge might be 100,000 sec. ft. In this case the emergency dams would be used to stop the flow and they would be in position 25 minutes after the emergency signal was given, and the other side would still be available for traffic. In order to prevent damage to Miraflores Locks from such an accident at Pedro Miguel a spillway is provided having eight gates which would prevent Miraflores Lake from rising above a safe elevation.

NEW BOOKS, ETC.

THE DESIGN OF MARINE ENGINES AND AUXILIARIES. By Edward M. Bragg, S.B. New York: D. Van Nostrand Co., 1916. 8vo.; 183 pp.; 110 illustrations and folding plates. Price, $3 net.

The author, who is Professor of Naval Architecture and Marine Engineering at the University of Michigan, has given us a very capable work on marine engine design, dealing with the determination of cylinder dimensions, the design of engine parts, engine balancing, condensers and air pumps, and turning and reversing engines. Although much of the material is of necessity drawn from pre-existing sources, the time and effort spent in the correlation of various findings are quite evident, and there is also much strictly original matter on methods of general design, the obtaining of mean bearing loads, the use of the mean lead in the solution of valve diagrams, and methods of designing condensers and turning engines.

HANDBOOK OF CHEMISTRY AND PHYSICS. A Ready-Reference Pocket Book of Chemical and Physical Data. Cleveland, Ohio: The Chemical Rubber Company, 1916. 12mo.; 410 pp. Price, $2.

A great variety of useful information is packed into this handy little reference book, and it has already proved a most desirable accession for the laboratory and classroom. The tables, compiled from the most recent authoritative sources, cover general chemistry, the properties of matter, heat, hygrometric and barometric practice, sound, electricity and magnetism, light, and miscellaneous subjects, with various definitions and formulae, problems and recipes. The aim has been to provide a work that shall fill a place not hitherto occupied—a place between the restricted reference material found in the ordinary laboratory manual and the exhaustive offerings of larger but more unwieldy volumes.

A CRITIQUE OF THE THEORY OF EVOLUTION. By Thomas Hunt Morgan. Princeton: Princeton University Press, 1916. 8vo.; 207 pp.; illustrated. Price, $1.50 net.

This interesting volume contains the Vanuxem lectures delivered at Princeton University in 1915-16; it constitutes a summary and an appraisal of both old and new evidence in the case for evolution. The first lecture puts a new valuation on traditional tenets; the second deals with the most recent work, on heredity, since only inherited characters can become a part of the evolutionary process; the third lecture discusses the physical basis of heredity and the composition of the germ plasm stream in the light of our most recent knowledge; and the fourth lecture develops the thesis that chance variation combined with a property of living things to manifold themselves is the key note of modern evolutionary thought. The work is thoughtful and scholarly without the least manifestation of pedantry, and it brings before the public a series of fascinating facts and important conclusions.

THE PREVENTION OF DISEASE. A Popular Treatise. By Kenelm Winslow, B.A.S., M.D. Philadelphia: W. B. Saunders Company, 1916. 12mo.; 348 pp.; illustrated. Price, $1.75 net.

The keynote of Dr. Winslow's commendable effort is Cabot's dictum that "The great hope of modern medicine is the prevention of disease"; most evidently this hope and this remedy are vested in the individual rather than in the physician, and, recognizing this fact, it is to the layman that the author addresses himself. The work is a detailed, practical guide to the avoidance of common diseases, in which the first three chapters are given over to healthy habits of living; these chapters include food, drink, and exercise. In that portion of the book dealing with diseases, the newer knowledge has been placed at the disposal of the reader in unmistakable language; the germ diseases, cancer, arterial troubles and premature old age, and the diseases of childhood, all are sensibly discussed and their prevention considered. Some of America's leading physicians contribute introductory notes to the various sections, and these contributions constitute a merited endorsement of the work.

THE STANDARD CYCLOPEDIA OF HORTICULTURE. By L. H. Bailey. New York: The Macmillan Company, 1916. 4to.; illustrated. Price, $6.

The American horticulturist, whether amateur or professional, will find this work in six volumes a most able compilation, carefully describing the plants commonly grown in the United States and Canada, including both purely ornamental flowers and trees and the useful fruits and vegetables. As an example of the thorough treatment, we find under "raspberry" the derivation of the name and the species to which it is applied; this is followed by a description of the roots, canes and fruit, with a statement of the characteristic distinguishing the raspberry from the blackberry and the dewberry; some three hundred words are devoted to the origin of the horticultural varieties; the geographical distribution of the fruit is indicated, methods of propagation are given, and there are sections on culture, training and pruning, picking and handling, varieties, and enemies. Eleven illustrations show the habit of fruit-bearing, systems of training—the hill, the solid row, and the various trellis systems, and the crating of the berries. The work carries numerous full-page illustrations, some of them in colors, of unusual beauty; it is already favorably known, and this second edition has provided opportunity for rewriting, enlarging and resetting, greatly increasing the attractiveness and value of the work to all horticulturists.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14194) J. W. B. asks: A metallic body possessing a kinetic energy of the 500,000 foot-pounds, needs to be brought to an immediate stop. Would it be possible to bring this body to a stop by passing it across a magnetic field? If so, what electro-magnetic energy (volts-amperes) would be needed to effect this stoppage? Or could this be done by electrical means? Can you refer me to reference works on this subject? A.—We know no way by which a body possessing a large kinetic energy can be brought to rest instantaneously, excepting by its striking a body with a greater resistance. The amount you name, 500,000 foot-pounds, is equal to 577.5 kilowatt-seconds, but an electro-magnetic field could not bring a body to rest instantaneously. As the body enters the field the resistance to its motion would be small at first and would increase as it came into the stronger parts of the field. Such a retarding force could not be exerted by an opposing field. That is, the moving body must possess an electro-magnetic field opposite to the field into which it plunges. We have no references to books upon this subject.

(14195) E. R. W. asks: 1. Can you explain the cause of the movements of the gyroscope? If there has been no explanation, can you tell me whether or not there is a prize offered for such explanation? 2. Why is it that sometimes in blowing the breath it feels cold and at other times warm? A. 1. For an explanation of the motion of the gyroscope we would refer you to the Encyclopedia Britannica, 11th edition, Article "Gyroscope and Gyrostat," which covers 20 columns with the mathematics of the instrument, very closely printed, by a professor of the British Ordnance College at Woolwich. If that work is is not accessible we can supply you with Crabtree's Spinning Tops and Gyrosopic Action, price $2.25, and Cordeiro's Gyroscope, price $1.50, which give simplified demonstrations, less mathematical. There is, so far as we know, no price for any further demonstration. Mathematicians consider the subject well covered by the work now available. 2. If one breathes gently upon a surface the moisture of the breath is condensed upon the surface and the heat of condensation is liberated so that the surface is warmed. This is "blowing hot." If one breathes forcibly, blows the breath over a moist surface, provided the breath is not completely saturated with water vapor, the breath will take up water—that is, water will be evaporated from the surface, and the surface will be cooled. This is "blowing cold."

(14196) A. G. C. asks: During the last two years large amounts of war materials, supplies, horses and vast armies have been gathered in nearly every part of the globe and concentrated in a small area as compared to the whole. In the aggregate a total weight that is unconceivable. Will this additional weight that is being added to Europe have any effect upon the course of the earth in its orbit. Or effect in any manner the earth's revolving upon its axis? If we take a ball and fix a weight on one spot we know that the ball will not continue in the same course that the same ball would if thrown without the fixed weight. If this is true of a small ball, could it be true of the earth? If it could be true of the earth that additional weight artificially added to one locality would have a tendency to cause the earth to curve out of its ordinary orbit, how long would it be before the earth would come to some obstruction that would be disastrous? A. The weight of war material concentrated in the war area of Europe is but a minute fraction of the weight of the whole earth. The earth weighs 6 sextillion tons, or 6 with 21 ciphers after it. This number is so inconceivable that the change of the place of a few billion tons produces no appreciable effect on the center of gravity of the earth as a whole. If the center of gravity of the earth were displaced sensibly the earth would gyrate, wobble, as it rotated on its axis daily, but there would not be any change in the time of its motions, since the earth is not rotating against any resistance in space external to itself, so far as astronomers have determined. The course of the earth in its orbit is wholly independent of the distribution of the material of the earth over its surface. It is the center of gravity of the earth, which describes what we call the orbit of the earth and if this should change in its place in the earth the new center of gravity would become the point along which the earth would move, of which fact we should be wholly unconscious. A small ball acts in the same manner as a planet in this respect. If the center of gravity is not at the center of form the ball will gyrate as we see it while it flies through the air, but the center of gravity moves in a curve which is the orbit or path of the ball. This is true unless the shape of the ball is very extreme, and any change in the path is due to the resistance of the air about the ball as in the curved base ball and foot balls. The earth has no resisting material about it and it moves freely in its orbit excepting for the attractions of other planets. Many of the topics raised by your letter are discussed in a masterly manner in Moulton's "Introduction to Astronomy," just off the press, which we can send for $2.20 postpaid.

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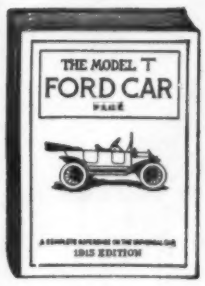

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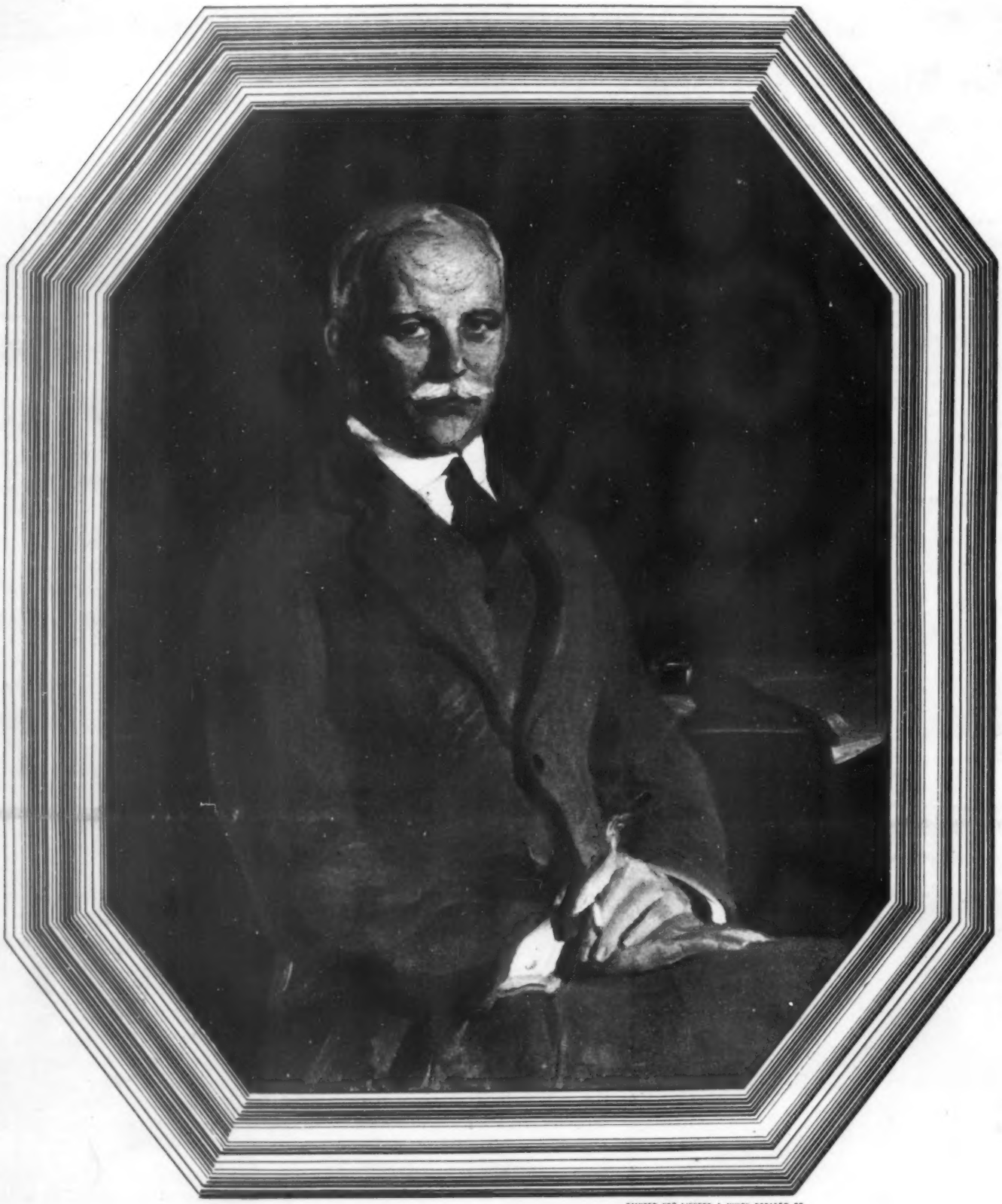

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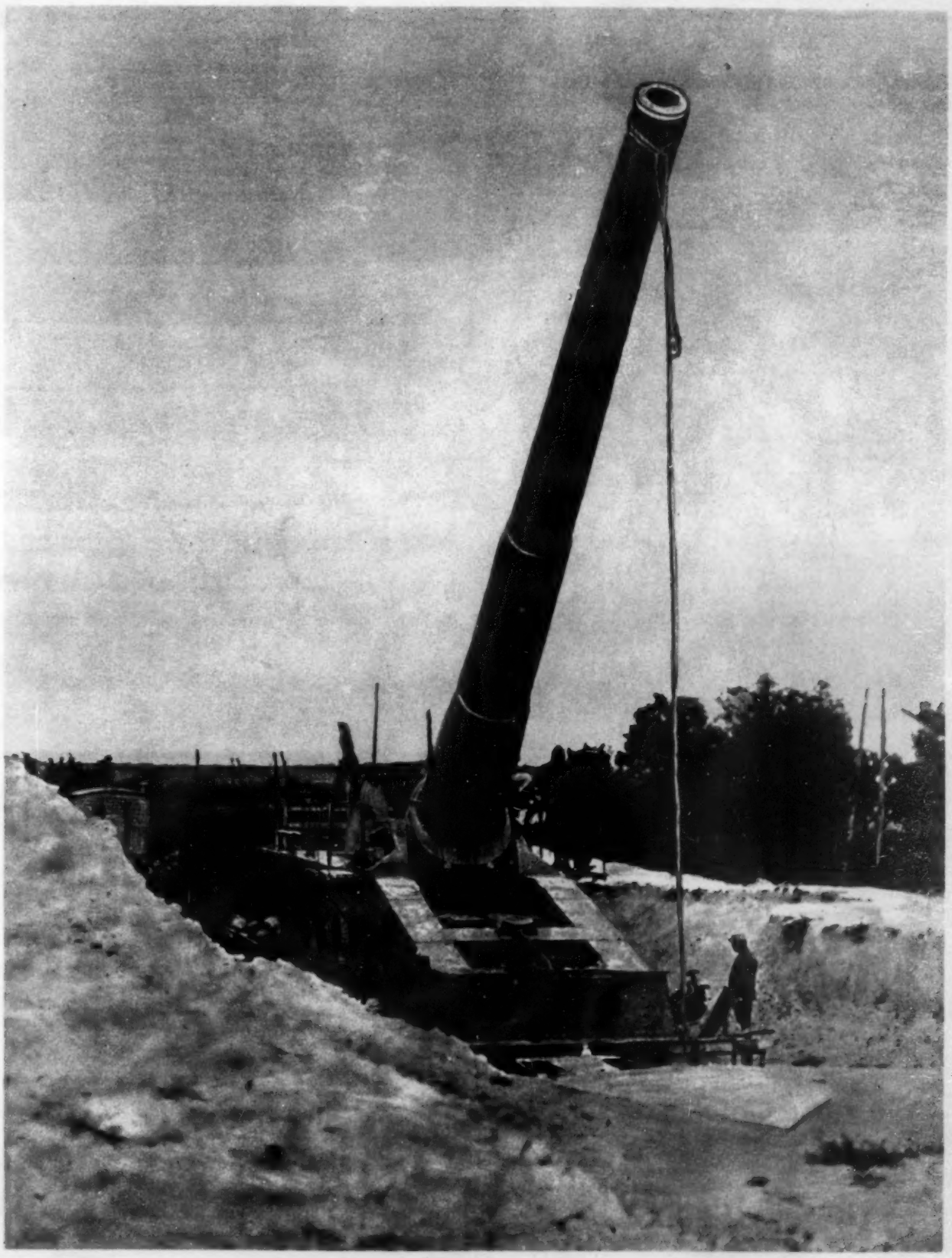

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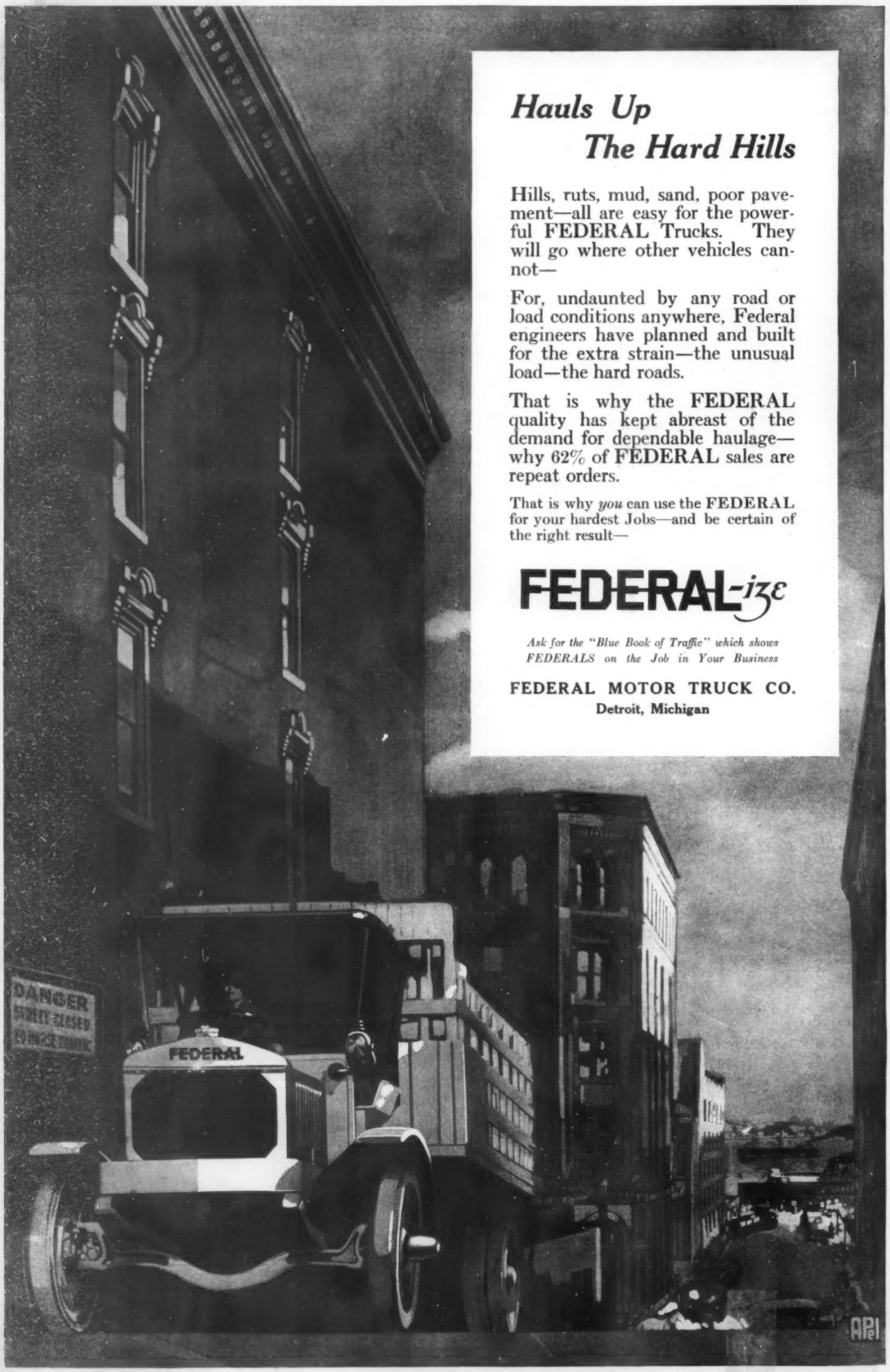

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